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AVIATION

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University of Illinois

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COMING

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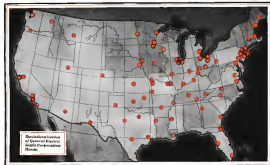


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5	Cleveland	11:00 AM	Fifth flight
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THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

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EDWARD F. WARNER, Editor

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Rate Regulation

A MONG the causes upon which development has been too much analogy. Superficial resemblances between aviation and some other industry or branch of transport have acted as a lure to imagine the parallel indefinitely extended. Airships, it was supposed, were to be sold as automobiles had been, for one apparent reason except that automobiles had been sold that way. Airships were to operate across the ocean in faithful imitation of the merchant marine. Domestic airlines in their traffic solicitation work and in their relation to the government were pictured as destined simply to repeat the experience of the railroad.

Such analogies have been bad enough when they merely led to the hasty introduction of practices in design, production, or merchandising which later proved unwise. They are worse when they cause a department of the government to get off on the wrong foot, for government moves with ponderous deliberation, and when correction is once required it does not easily reverse its course.

American railroads have been subject to close regulation of their rates for approximately half a century. In that time they have had all kinds of experience. Some of the regulatory work of legislatures and commissions has been economically sound and carefully planned, calculated to protect the interest of the public without disregarding equitable treatment of the companies' stockholders.

Much of it, on the other hand, was injudicious, hasty, and altogether too likely to stifle initiative of railroad management. All, however, whether sensible or otherwise, had a real reason behind it. The railroad had received from the government certain privileges which could not be disregarded. It had acquired its right of way by eminent domain, and in some cases, as notably in Pittsburgh, a very small number of roads had been able to acquire the only impermissibly favorable approaches to a metropolitan district, effectively prohibiting any future entry of additional competitors.

There is no such reason for regulation in the air. The operator of an airline has no natural monopoly. His highways are free to all users.

For rate regulation of air transport in the direct public interest, to protect the traveler against exorbitant charges, there is no work. Potential competition and the necessity of building up a traffic in the face of the established means of airship transport offer better assistance against excessive rates than anything that the Interstate Commerce Commission could undertake.

But there is another possible reason for some sort of control. Protection may be needed not only by the public but by the operator. He has the right, especially when he has pioneered a virgin field, to some measure of safeguard against unfair competition. Especially he has the right to protest against wholly irresponsible competition, which manifests itself only intermittently, when there is reason to be alarmed from the market. The operator who starts when there is no traffic, who carries on until he has built it up, and who gives service twelve months in the year should be protected against the rival who comes in with resources overboard, possibly with inadequate or unsafe ground organization, to fly only while conditions are good and to cut into the profit loss.

Much as we regret any addition to the great body of governmental regulation of commerce, we are constrained to hold the path that way of the motor bus runs have taken and alone ourselves among those who seek further governmental control. If air transport is to develop along sound lines, with a reasonable prospect of proper return to those who carry the major part of the burden, there must be some restraint upon competition, at least for the next few years. We want no rate regulation, but we do want the issuance of certificates of competency and convenience as a prerequisite before the opening of a new line. In the imposition of that additional regulatory legislation the potential good outweighs the undesirable features of one.

Salute to the Tanager

THE GUGGENHEIM Safe Aircraft Corporation reaches its end, and it must be accounted a success. The meeting of the extremely severe stipulations of the qualifying conditions by even a single machine assumes them. We set a very high riding upon the importance of the event. We believe that the men that it has given to engineering thought will have a profound difference for the development of better and grossly safer heavier-than-air craft. The aeronautical world will watch with special interest the further evolution of the most successful of the competing types.

It is too early to appraise the significance of the competition as a whole, but it would be impossible to be too prompt in tendering congratulations to the constructors of the winning plane and expressing admiration of their design. It is a striking testimonial to the value of research and to aeronautical engineering as an exact science that it was possible to produce, largely in a laboratory, a machine which within a few weeks of its first trials was meeting all the performance requirements with almost uniform margin of safety above the required minimum. It is especially satisfying to those who believe in progress by evolution that such notable results were achieved without radical departures from standard practice. Since from a hundred years away and rather recently examined, neither the Tanager nor the Handley Page, which was its nearest competitor, appear as very abnormal. Success has been achieved by good design practice, combined with mechanical ingenuity based on laboratory study, and by a skillful blending and incorporation of all known devices that would help towards the desired end.

It is warmly pleasing the Curtiss Company's achievement in producing the Tanager, we take special satisfaction in ascribing Mr. Robert B. Olden as the project engineer upon the design and as its shepherd from the first researches up through the completion of the trials. Mr. Olden has long been known to the readers of *AIRCRAFT* as the author of "Side Slips" and the faithful Roswell of the *Imperial Aviation*. Although such a happy mixture of professional ability and wit is by no means without precedent in scientific history, it is a rare one in the less rare. Our readers who have chuckled over his comments upon aeronautical happenings will join us in enthusiastic felicitation to the man behind the Tanager.

In doing homage to the victor we are not overlooking the perilled resources of some of the other competitors and the notable features of their design. Pioneering aviation is especially due to the Handley Page entry, the only one that labored under the disadvantage of being three thousand miles from its factory. After meeting almost all the tests successfully it finally went down to disqualification upon inability to maintain the required minimum speed in gliding, but it retains an important place in the history of the development of aircraft having safety of operation as a primary consideration in their

design. Not so much can be said of some of the other craft that were presented for trial. A few, including certain perfectly standard commercial types, served principally to reveal either the extraordinary opinions of their backers or a passive lack of knowledge upon their part of their own product's performance.

Although an editorial is no place for detailed technical discussions, any comment upon the contest would be wholly incomplete without some mention of the triumph won by the slatted wing. The virtue and the make-up, the only two machines to cause us to wonder to complete the trials that they were formerly put through the whole series, both used the slot. Both used it as an instrument of lateral control and also for the increase of lift coefficient and the reduction of maximum speed.

The competition is at an end, but there should be no breathing space. The next step is to put the developments that it has inspired into commercial use. We shall be very much disappointed if commercial types inspired by the Tanager and its closest competitors are not promptly prepared for the market, and especially for the service of the private owner.



Unavoidable Accidents

TWO thousand years of progress in science and in human thought have summed themselves up in the gradually developed conviction that nothing happens without cause. Natural phenomena that the ages of ancient courts attributed to the whimsical action of gods acted by an irresponsible and arbitrary humor have been traced to their proper place in an orderly cosmic scheme. Nothing happens without cause. Airplane accidents are no exception to the rule.

The term "inevitable accident" is one that we should shun as one of the personal debris of aeronautical development. There is no such thing. No accident happens without a reason, and where reason exists avoidance would always have been possible by its removal. Always there is some defect in the machine, the man, or the surrounding conditions which could have been overcome if it had been foreseen.

Not due to a moment, also, do we dare to suggest that all accidents are practically preventable at this time. Theoretically, every one of them is avoidable. To claim otherwise is to make an admission admission of ignorance that hampers us a little, for a fact is fact, scientific knowledge is even yet infinitely incomplete. We can see afterwards how we might have avoided trouble, given enough information at the time, but it is too much to expect that we should infallibly foresee. Accidents may happen with no one in any sense to blame. If the same mishap occurs a second time it is more difficult to explain. If lightning strikes still again in the same place, excepting only those cases where the primary

January 11, 1919

cause of the trouble lies in the working of natural forces for which research has as yet provided neither complete explanation nor means of forecasting, the occurrence is not only avoidable but inexorable.

It may not even be practically possible, in many instances, to discover the cause of tragedy. These are catastrophes which will go unexplained to the end of time, but we must not be content to make admissions to their number. Not only are accidents not "inevitable," they are not even, strictly speaking, unavoidable. The cause is there, if only we can set upon its trail men clever enough to hunt it out.

"The fault is not in the stars, dear friends,

But in ourselves that we are underlings"

One of the great perils that confronts the aircraft industry is the adoption of a philosophy of resignation. No one dares that present-day flight performances are good enough or that the effort to improve them should be abandoned, but the subject of accidents is an unpleasant one and there are some who would prefer to avoid it by supposing that all is now well or that there is no reason to anticipate the possibility of further marked advances in safety. Against that thesis this magazine men up its arms. It will not do.

The effect of our own mental attitude upon our own action is vital. The effect upon the general public is quite as much so. When the layman hears talk of "unavoidable accidents" has gradually growing confidence wavers at the root. The normal expansion of that phrase from the language will be the symptom of a very healthy trend in the aeronautical community's psychology.



Faithfulness in Little Things

A SENSE of proportion is a valuable possession, but it sometimes proves misleading. An enterprise which must deal with the public sometimes finds its standards personally sufficient in the big and the important things, surprisingly short upon the trivial ones. We know a subway system which strived up for itself a large amount of negative good will on the debit side of the ledger by using a two-wheeled wheel on an existing way of swaying around and strutting the passenger as he went through. We recall a railroad which gave excellent service, accident-free and true to schedule, but against which a considerable group of its passengers started a holy war because of the uncomfortable curve in the backs of the seats in the coaches.

Air lines are still in a relatively primitive state of development. It is natural that attention should have been concentrated upon questions. Only very recently has there been time to spare for the amenities. Even now they generally receive less attention than they deserve. What air transport needs is more traffic. We cannot make that desideratum too often, or phrase it in terms

as strong as it deserves. Passengers are not to be attracted solely by performance, nor even by performance and safety. An airmen fifteen miles an hour may easily mean less in dollars at the ticket office than a little improvement in seating arrangements or ventilation, or in the attractiveness of passenger terminals, or in the convenience and cleanliness of lavatories. There have been great improvements in such matters in the last year, but even very recently we have seen instances of shocking neglect.

The tendency towards the employment by transport lines of specialists in passenger comfort and in the provision of the little trifles and luxuries that make for a pleasant realization of the trip is all to the good. In considering it further, it should be remembered that the point of view to be taken is that of the passenger completely ignorant in aeronautical law. Most of the officials of an air transport company cannot know too much about flying, its theory and its practice. Every bit of information that they acquire increases their usefulness. But there should be a few whose value depends upon their knowing very little of that subject, and upon their being able to preserve the casual attitude of the aviator. It does not detract the passenger that the things he wants in a machine are absolutely unaccounted for or that they would add an unpalatable amount of weight. He knows only that he wants them. If he cannot have them, it makes no particular difference to him what the reason may be. There should be a department in the organization which is charged with interpreting the passengers' wishes in terms of an ideal. Someone else may then have to decide that the ideal cannot be realized, but the specifications should be written without any of the inhibitions imposed by a special or technical knowledge which the average traveler will not possess.

Attention to insignificant detail does not concern itself exclusively with passenger comfort. It enters into the work of the airplane designer, and the improvements in performance in the last few years have been largely due to a progressive clearing up of details too trivial to have received attention before. It enters into safety work, and we must guard against watching the big and dramatic features of hazard with such attention that we neglect the little things that decide whether or not an accident is serious. The angle at which a landing gear is attached, the way in which a cabin door is fastened in its frame, the anchorage of the safety belt for the protection of any safety belt at all in the case of the big (size matters), the padding around the cockpit cushioning—such things have saved many a life. Neglected or shorn off in favor of matters of "mere appearance," they have been responsible for many a death or serious injury.

Equal vigilance is the price of safety. It is the price of public popularity. It is the price of financial success. It must not be fixed upon one or two or a dozen apparently critical points, but must cover the whole horizon in a constant watch for imperfection.

European Aeronautics AND

AMERICAN FOREIGN

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JOHN T. NEVILL

Business Editor of Aviation

by

LEROY MANNING

Chief Pilot, Airline Division, Ford Motor Company

A NUMBER of American government and private business officials—experts at the promotion of trade relations between the United States and foreign countries—are confidently pointing out to America's industries the importance of developing export trade. Again and again they have outlined the numerous and more or less obvious advantages of increasing the distribution of American-made products in other lands.

In the aircraft industry, fortunately, that counsel has not fallen upon unheeding ears. Having reached a point where domestic consumption alone is no longer facing

production capacity, American aircraft manufacturers and their kindred concerns are day by day devoting more time to building up markets beyond our own political borders. For several years, in fact, a policy few members of the industry have been shipping an equally low ratio of their respective production across the international boundaries. But much of this business has been merely a matter of "order taking" as a result of individual aerial exploits, rather than sheer salesmanship in the countries taking delivery on such orders.

The individual exploits, such as those of 1937, have

planted the seed of American trade in the foreign mind. But the dignities of Lindbergh, Chamberlain, Schlie and Brock, Byrd, Gossel and others have served their principal purpose, consistently speaking, and little more can be expected of them. Figuratively, the salesman's call-book has been returned with a favorable message. Now it is up to the salesmen to walk in and sell his merchandise.

In the rather limited experience record already written the Dominion of Canada and Newfoundland have been shown to be our best markets for aircraft and aircraft engine exports. During the years 1925, 1926, 1927 and 1928 Canada and Newfoundland purchased \$2,017,659 of the \$2,125,267 in airplanes and engines exported during those years. Europe was our second best customer, taking \$1,880,497 of the total, and South America was third best, with \$1,661,732. The figures for 1929 will show Mexico and Central America as our best patron, and South America our second best, with Europe and Canada trailing far behind.

Facing an initial cost, standpoint the development of a foreign market is usually a costly undertaking. Hence it has remained for some of our most financially resourceful manufacturers to take steps to check the sharp desires they see in the European and Canadian markets. The Canadian desire is not nearly so discouraging as statistical figures would indicate, because of the establishment in the Dominion of airplane factories operating subsidiary to American concerns.

Because of the peculiar nature of the development of so-called "commercial aviation" in Europe and because of the easy political restrictions there, that region of the world presents a most unenviable situation to American manufacturers who see in Europe a prospective market for large amounts of American-made aeronautical products. How these unenviable elements can best be overcome will remain for time to tell. Perhaps it will be found economic, ultimately, to target experts, in the strict meaning of the word, and sell American planes in Europe via channels now employed in Canada. Moreover, however, at least one American airplane

With European countries setting up their own particular aeronautical requirements, the task of American manufacturers invading foreign markets is made that much more difficult. There does exist, however, a profitable market on the other side of the Atlantic. It is there to be developed, and it would be well worthwhile if American manufacturers gave serious regard to that fact. Leroy Manning has recently completed a most extensive sales and demonstration tour through Europe in a stock model Vaux equipped Ford transport. His observations and opinions as set forth in this article are worthy of notice and should be thoroughly digested by all who have hopes of profits from foreign markets.

manufacturer has made a strong bid for European business by the straight-tube-the-shoulder method of scaling one of his products on a demonstration tour of England and the Continent. We refer to the highly portable light aircraft designed by Chamberlain and J. Parker Van Zandt in a stock model 3-AT Ford monoplane.

Mr. Manning, chief pilot, Airplane Division, Ford Motor Company, and operations manager of the Ford airbuses, returned to Detroit without his demonstration. He had sold and delivered it in its proper element, where it will be used on the routes between Prague and Bucharest, Roumania. Since his return, and as a direct result of the tour, another Ford product has been shipped to Madrid, Spain, and the company, Mr. Manning says, is now negotiating with a number of prospects whose interest was aroused by the European field.

Mr. Manning was asked for details of the demonstration trip and here is his reply:

"By way of answering your question, what has Europe to offer in the way of a market for American airplanes, let me tell you something about our demonstration tour. Our plane, a stock Ford monoplane, equipped with three Pratt and Whitney Vaux engines, had been exhibited at the Olympia show in London from July 16 to 23. In its own right the European reputation for building large passenger carrying aircraft, our plane was the largest actually exhibited in the London show in complete form.

"On August 3 we started from Croydon on a tour that was to take us over approximately 9,000 miles of European airways, to about 40 cities in 21 different countries, including the major capitals of the Continent. During the three months of the tour we carried approximately 1,250 passengers, a majority of them being European aeronautical executives and pilots, this over and above the hours accumulated in flying the tour. We presented many of the pilots to take the controls and fly the



The Vaux-powered Ford transport used by Mr. Manning on his European tour at Waltham Airport, Waltham.

plear themselves, thereby giving them a taste of the universality of our plane and at the same time, building up their mood.

"Our route took us first to Paris, then to Cologne, and Berlin, Germany. After Berlin came the following cities in the order named: Dusseldorf, Kassel, Bonn, Frankfurt, Moscow, Warsaw, Poznan, back to Berlin, Dessau, Trossenrode, Capellen, Maastricht, Hamburg, Rotterdam, Amsterdam, Coblentz, back to London. Manchester, again back to London, Brussels, Antwerp, back to Paris, Geneva, Zurich, Fribourg, Bern, Munich, Prague, Vienna, Budapest, Belgrade, Balkans, Constantinople, Sofia, Saloniki, Athens, Brindisi, Naples, Rome, Venice, Milan, back to Munich, and then to the termination at Prague. During all this time we carried only a small amount of spare parts. Even this was useful as we experienced no trouble with either engines or plane. That fact, alone, was convincing proof of the reliability of American-made airplanes.

"That the European people are intensely interested in what we here in the United States are doing in the way of aeronautics was best demonstrated by the crowds that came to the various airports to inspect our plane. Of course, we advertised our scheduled arrival and advertised during our stay in each city; but, even so, I cannot imagine any stock market, sea-fair, European airplane driving a similar crowd anywhere in this country.

"**T**HEY STURDY BELIEVE that it was a mock model job. Even the newspapers declared, with considerable emphasis, that it was an especially built plane and equipped with a lot of 'extras' for display in the London show. They were amazed, also, when told that our wheel braked, our torque engine started, and our tail-wheel were standard equipment on every plane turned out by our factory. The ground maneuverability afforded by our wheel braked and our tail-wheel, undoubtedly, furnished us with a lot of applause. At nearly every airport we landed a group of mechanics and airport attendants would come out to help us turn the plane toward the proper direction. When we landed a wheel and released the tail wheel, within an area of several acres they were surrounded.

"Hearing in word all that we read about Europe's latest transport planes, its marvelous maneuvers and airlines, its government subsidy, its security and its smooth work, it is difficult to believe that the average European mind would expect anything but polite indifference to our best efforts. Five years ago Europe had her passenger airlines operating on regular schedules, and we had nothing except one government-operated air mail line. Today, despite our late start, our air transport operators have flown approximately 16,000,000 miles, one third again as much as the combined air transport mileage of Germany, England and France during 1928. Since 1929 Germany, France and Great

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Britain have been among the "big" out of their equipment and their air transport service.

"Most notably Belgium, Denmark, Czech-Slovakia, Finland, Italy, The Netherlands, Poland, Rumania, Sweden entered the transport business. Their increased experience, naturally, has persuaded them to perfect a very satisfactory system of public service. The attention they give to detail, to the everyday comforts and conveniences of the air traveler, is impressive to say the least.

"Yet, they seem to have developed that one last point somewhat at the expense of other important factors in successful air transport. I mean by that that their equipment has not kept pace with the type of service they render. I did not observe a single airline in Europe with anything like the modern, reliable, and efficient equipment in daily use on any of the airlines in this country. And that fact, alone, has helped to create the market shock which we are talking.

"We speak of European 'commercial aviation,' although, in reality there is no such thing. Every operator in Europe is subsidized by some government, as you know, and some of the subsidies are as high as \$3.04 per mile. That is a higher rate of subsidy than it costs us to operate our planes. And still they are making no profits. That does not speak well for the efficiency of their planes, yet that seems to be the only answer to the question. The French government in 1928 spent \$4,480,000 in air transport subsidies, alone, not to mention \$5,510,000 devoted toward the promotion of civil aviation and \$32,260,000 toward furtherance of military and naval aeronautics. Great Britain appropriated \$1,119,500 to air transport subsidies, \$2,550,000 to civil-aeronautic interests, \$7,000,000 to military aviation, and \$77,800 to private flying clubs. This country, as you also know, has no direct subsidy at all, the closest approach to subsidy being our well equipped airports, the service rendered as free of charge by the Department of Commerce, the losses we may incur from the various military and naval experiments and the equipment our government purchases from us.

Other than Germany, which country, of course, is



Officials of the Junkers factory inspect the finished transport of America.

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Above: Third picture of the all-engined Ford now Germany during the recent take-off of Baltimore. Below: Another view of the transport now International Airlines.



restricted to commercial development, the governments of Europe are chiefly concerned with the promotion of military aeronautics. That is one big reason they are powerless in their support of development along so-called civil lines. But they have never made a serious attempt to master the trick of mass production. When we told them that competing to-morrow Ford manufacturers almost identical with the one they were looking at were rolled out of our Detroit factory three or four times every five-day week they simply could not believe it. Of course, that really is not mass production as we speak of mass production in this country, but it was enough for our European friends to wonder at, none-the-less.

"In Europe they do much of their work by hand, consequently their production is very low. That helps to bring the cost of their airplanes up, which is another reason we have a market in Europe. American manufacturers, with anything approaching a fair production, can well underbid any manufacturer in Europe, and still

make a profit. To cite an example in our own class, there is a freight all metal transport equipped with three engines of around 400 hp. and widely used on German lines. Its performance is inferior to ours, and the plane sells at about \$98,000, or more than \$40,000 in excess of what we put for our costliest stock job.

"Speaking of performance, might I say that we were backed at when answering questions relative to what our plane could do? They did not believe us and made no 'bets' about letting us know they didn't. Now, that doesn't sound reasonable in what nations of our own country's accomplishments call 'underdeveloped Europe,' does it? Yet, that is what happened. So we proved our claims. An official of the Czech-Slovakian airlines, the purchaser of our demonstrator, asked us how quickly our plane would climb to the first thousand meter elevation carrying full passenger load. We told him it would do it in 4 minutes.

"Deposited," he exclaimed, shrugging his shoulders, as if he had under-estimated his intelligence.

"Watch us prove it," we said, and proceeded to do so. In fact, the plane's climb bettered 4 minutes by a safe margin. When we landed he wrote out a check and proceeded at once to deliver the plane at end of our tour. "That is it that Europe, generally speaking, does not seem to realize the progress we have made here in America. Europe, with her airlines and 'municipal' airplane factories 10 years old recalls that we had nothing five years ago. She cannot believe that during those five years, we have surpassed her in many respects, first among which respects is that we have learned to build a profit-making airplane at a profit without direct subsidy of any kind. Further than that our commercial airplanes can out-perform hers, and will further, we can make a profit selling our planes at prices considerable lower than their.

"Europe is producing no airplanes capable of making long trips. The planes being used on her airlines are costly, inefficient, uncomfortable, obsolescent, and rendered so very quickly as to necessitate a high cost of their airplanes that they maintain remarkable fidelity to schedule despite the topography and weather with which they have to contend, but they rely to a considerable degree on American patronage. Their engines are either old, with the result that their planes come at all a run gyring with exhaust smokes, which is not a comforting sight to the casual air traveler. Our plane, bearing normal oil, would lead on the various airports almost as they and

system as when we took off the preceding airport. As a matter of fact, we had difficulty persuading some of the students that we had not landed somewhere between points to brush it up.

"Each European country is following its individual conception of aircraft, and there are marked differences in the trend of design in the different countries. England has a preponderance of military craft. There they are following an interesting method of stainless steel construction. They also are devoting considerable attention to building aerial flying boat hulls. In Germany the tendency is toward large heavy-duty craft—all metal winged monoplanes and flying boats of unusual passenger capacity, some of these designed with an eye toward trans-oceanic service.

"France and Italy did not seem to have any particular objective in design or construction. These planes covered a wide range of types, including several different classes

"The market among private individuals in Europe is as yet untapped, except in England where the light plane club idea has been developed to a high degree. Unless other countries on the Continent adopt a similar policy toward encouraging establishment of such clubs, that particular market is likely to remain negligible for some time, due to the general economic condition prevailing over there.

"Increasingly serious the manufacturers of all-steel monoplanes, of which there are several in this country, have the best opportunity in European export trade. Europe has established airlines and from time to time is establishing more. This means occasional new equipment for replacements and increased equipment to take care of the new lines. The numerous over-oceanic and over-water routes favor the multi-engine type for safety reasons and climatic conditions practically demand all-metal construction. The extremes of climate between northern Europe and the Colonial possessions in Africa are something to wonder at. Germany and Russia are working in metal not only because of its availability and strength, but because it is the only practical substance that will stand up under their rigorous climate. In Africa, seriously enough, it isn't the terrific heat that sets such a airplane's covering so much as it is the severely rendered insect.

"Here in the United States we occasionally read about a laundry hose or saw ribbing a fabric covered airplane into the reversing department. In Africa, India, South America, or any other country where insects are known to be voracious, manufacturers of metal planes can well use the lovely insect as a sales argument.

"Seriously though, the American airplane maker seeking a lucrative export in Europe, faces a number of discouraging obstacles, chief among which is governmental subsidy. In the final analysis the governments themselves are the purchasers and naturally enough, they do all they can to patronize the airplane they help support. Even among the nations of Europe, the Continent's tangled political boundaries with steelhead red tape and endless complications has made the manufacture of aeromarine products exceedingly unattractive.

"Because of the aircraft features in such countries as England, France, Germany and Russia, I would say that American airplane manufacturers have very little chance for exportation to those nations as long as the present subsidy system is in force. That, of course, eliminates a large portion of our prospective market and some nations are bound to get around this barrier so trade. Meanwhile there are many other countries in Europe, countries having no aircraft plants, that can use air transport to an economic advantage. The Ford Motor Company has delivered planes to Landothovian and to Spain. There are just two countries to which I refer.

"Aircraft displayed in the necessary equipment in our plane seems to indicate that this country's aircraft accessory producers have a potential market throughout Europe. Tail-whisks, wheel brakes, instruments of various kinds and ground equipment are some of the items they seemed to lack.

"Europe has many, many miles of passenger airlines and needs profit-making airplanes. We, in America, are certain we have the airplanes they need. Therefore, it is up to us to figure out some way to cultivate their business. Presumably, I believe the answer lies in just such demonstration tours as that which the Ford Motor Company has completed."



THE CONSOLIDATED "Commodore" FLYING BOAT

A Description of the Commercial Adaptation of the Navy XPY-1

By LESLIE E. NEVILLE
Technical Editor of Aviation

THE CONSOLIDATED COMMODORE, Model 16, largest commercial flying boat to be built in America in the United States, is now under production at the plant of the Consolidated Aircraft Corporation, Buffalo, N. Y. A production unit of twelve of these craft is now under way to fill an order of the New York Rio and Buenos Aires Line, Inc., which is now operating an regular schedule between South American ports and is planning to extend its service to New York. Several of the Commodores have been delivered and are now in South American service.

The Commodore is a central hull, monoplane flying boat powered with two Pratt & Whitney Hornet engines rated 375 hp. at 1,800 rpm. The craft has a wing

span of 100 ft., a length of 64 ft. 9 in. and a height on landing gear of 16 ft. Its weight empty is 9,783 lb. and its gross weight 17,600 lb.

It is stated the Commodore is the commercial adaptation of the XPY-1 Navy patrol boat built by Consolidated under a contract awarded as a result of a design competition. It was designed by J. M. Luciani, assisted by Florence Plater and J. L. McClure. Hull lines were developed for the original flying boat by Captain Holden C. Richardson of the Bureau of Aeronautics, Navy Department.

Wind tunnel tests of a model of the consolidated XPY-1 showed a maximum L/D ratio of 11.4. The



The Ford powered Ford transport on display at the London International Aero Exhibition, July, 1935

of construction in each type. Most of them were designed for military use, or with a view toward meeting some world need.

"ALL of these monoplanes should interest the American manufacturer that the European market is one to win. What I have said about our plane is similarly true. I believe, of almost any other type of American-made plane offered against a European-made plane of its class. I have said our plane as an example of America's unexcelled superiority because that is the plane with which I am most familiar and because that is the plane with which we made the tour. It occurs to me that there should be a very definite market in Europe for the single engine craft exemplified by the four, five or six plane type. That is the type most popular in this country and a type European designers have neglected almost entirely, although DeHavilland recently brought out a four place job of that design powered by an Armstrong-Siddley engine of 240 hp. DeHavilland, incidentally, is just about the only commercial airplane manufacturer in Europe with anything approaching real quantity production.

One of the latest Commodores showing the retractable landing gear.



advantage of moving the engines to a point above the wing was maintained at this time and the model was modified with this idea in mind. Tests of the modified model showed that the maximum L/D was not reduced to 75 by this change and the drag at all angles of attack was increased to a prohibitive extent. The L/D ratio of the original model is attributed to the high aspect ratio (48) wingplan wing and to the general closeness of design. Placing the power plants above the wing was abandoned also because it was believed that it would result in an increased landing speed due to the fact that the propeller disk areas would block off a relatively important percentage of the air reaching the wing when the engines were idled.

Model basin tests of the *Admiral* or XPY-1 indicate a peak required maximum power at 53 per cent of the gross weight or approximately 3000 hp. per hour. In actual tests this was not achieved, acceleration being uniform and rapid until take off. With a gross weight of 13,600 lb. the XPY-1 takes off in 31 sec. in still air and under the same conditions with the gross weight increased to 16,000 lb. the climb requires 45 sec. to take off. Camouflage performance is on a par.

Practically all of the aerodynamic features of the XPY-1 are retained in the *Commodore*, the modifications being mainly structural. A crown deck has been substituted for the cylindrical deck of the patrol boat to provide additional headroom for passengers and sailplane berths for the possible introduction of sleeping berths.

The mainplane wing is of constant chord, this value being 11 ft. 6 in. throughout the span. A Goetzinger 3.06 airfoil section is employed, affording a good combination of maximum L/D and low stall drag for such a long span. *Admiral* type balanced ailerons and have a total area aft of the hinge of 170 sq. ft. The 1,110 sq. ft. of wing area is so distributed that 307 sq. ft. maintain the center section and the remainder of the two wing panels. The angle of incidence is $+4^\circ$ dir., while the dihedral angle is 2 deg.

In order to facilitate manufacture of the first *Commodore* the hull form was left down to full scale on a smoothly finished floor board 73 ft. long and 23 ft. wide in the engineering department. From this layout, full size templates were made of all of the necessary sections and sent directly into the shop for use. This practice has certain obvious advantages and it is especially an advantage of the "mold box" used in the construction work of ship-building firms.

Because the outstanding features in the construction of the *Commodore* are the extensive use of fittings and the open sections used in the structure, the advantages of open section construction being accessibility of members for riveting and elimination of the possibility of internal corrosion. Particular care has been taken to avoid hammering of the skin, the only sug-



A photograph taken during the building of the hull of the *Commodore* in Seattle.

gest irregular shape being found at the nose. Forming of this member is done on a Pettibond No. 2 hammering machine. Small joints are hand hammered. It is noteworthy that a minimum of sheetmetal bracing is employed in the structure and a large percentage of the weight of the floor system is carried by longitudinal members which also contribute to the general strength of the hull.

With two exceptions of the fabric covering the wing of the *Commodore* is built entirely of metal. Aluminum Company of America designation 17ST alloy being used. Spars are of the Warren truss type having extruded bulb T sections for the flanges and back to back channels for the web members. These members are separated at the center by spacers. The flanges both top and bottom are joined by lighter aluminum alloy extruded trusses which act as drag truss compression members. Double drag bracing is used with one set of wires in the plane of the upper flange and one in the plane of the lower. The T section flanges are finished with a cover plate of extruded aluminum alloy.

Ribs are also of Warren truss type formed from strip steel rolled to channel section. Connection between the flange and web members is made by means of a semi-V shaped aluminum alloy flange, fitting inside of the channels and providing an overhang space for four 1/4-in. diameter through rivets. The ribs thus constructed weighing approximately 2 lb. each and under low and high incidence static tests without substantial overloads. The main beams are built up as jigs by means of spaced riveting. Aluminum spacers are used whenever possible in final assembly.

One last task, 315 gal. capacity, is set between the spars in each of two compartments of the center section. Oil tanks, each having 25 gal. capacity, are placed in each end of this section. The drag truss is made up of top and bottom chord members of extruded bulb T section, while the web members are extruded bulb angle sections in Warren truss form. Center section ribs are standard. This structure is protected by red oxide and zinc chromate of Navy department specification, while the final finish is beige or aluminum enamel.

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Prings are of chrome molybdenum steel and all sheet metal of this specification and is finished in heat treated to 125,000 lb. per sq. in. 75 after welding. Following the heat treating members plating is applied.

External bracing of the wings consists of stainless aluminum alloy tubing. The forward outboard strut is driven from a 3 in. OD aluminum alloy tube of 0.434 in. gauge material. It is used to be the lightest member of the type thus far used in aircraft production. Two other special sizes of stainless tubing are employed, both being driven from 4 in. OD aluminum alloy tube of 0.148 and 0.09 in. gauge respectively. In addition to these three sizes, two Aluminum Company standard sizes of stainless tubing are used.

THE HULL, under present production methods, is built in inverted form. Bulkheads are set in place in jigs and all of the structural members of the bottom are put in place at this position. After the bottom plying has been applied, the hull is turned to normal position and the sides and upper structural members are added. This is followed by the application of the plating for the sides and the top. Bulkheads at 1038 plate are provided at appropriate intervals, the sheet metal being secured by riveted bulb angle section channels alloy. Extruded longitudinal struts of bulb angle section are riveted to the deck and bottom plating on approximately 2-in. centers throughout the deck area and much closer than this along the bottom. These longitudinal struts are supported in turn by intermediate floor frames built up of extruded angle and channel section members in the form of a truss. These floor frames are supported at five points, the two chine, the two bottom plate girders and the central keel truss. The hull analysis was made in accordance with novel mathematical methods being extruded loads on three centers:

- 1—Hanging condition with the crest of the wave on deck.
- 2—Sagging condition with the trough of the wave on deck.
- 3—Landing condition with the load concentrated in the bottom forward of the step.

These were the determining factors in the thickness of plating, spacing of longitudinal struts, design of the floor frame trusses, the keelson and the bottom deck truss.

In the forward portion of the hull there are four floor frames between each set of bulkheads. These floor frames are formed and assembled in jigs. They are



Left: One of the dry bed sections. Center: View through the center passage. Right: View in the forward compartment.

made up of extruded bulb angle section members with two main crossers at the bottom. Plate girders are set 11 in. on each side of the center. The skin or plating is applied with spacers staggered and is made water tight by the application of cotton tape, soap and seps been composed.

In the process of fabrication the skin is held in place by small L-bolts and wedge down blocks, making it possible to drill the plating and structural members at the same time. The blocks are easily removable for riveting the skin to the structure. Following the completion of the bottom plating the completed hull is turned over as previously mentioned and at this point it is filled with water approximately to the lower chine as a test for water tightness.

The watertight splines in the plating are made up of a double row of staggered rivets. All existing surfaces are coated with varnish and assembled while the varnish is still wet.

No break is made in the structure to provide for the step, this not being built up by a V-shaped form piece, while the keelson girders and floor members are carried through. The struts are bent down to form the step.

Diagonal members, two from top to bottom of the main bulkhead and connect with fittings at the attachment points of the structure. They are reinforced by steel fittings riveted with the skin and are double at angle angle members, depending on the stresses to which they are subjected.

Forward members of bulkheads and bulk frames are cold worked and in heat treated condition.

THROUGHOUT THE construction section stress have been standardized to a high degree as practicable, the result being that stock sizes are relatively few in number.

In addition to the five sizes of stainless tubing previously mentioned, two sizes of extruded bulb T section material are used in the wing structure. These are 3in. x 1/4 in. and 2in. x 1/4 in. Two sizes of plate angles, 1/2 in. x 1/2 in. and 1/2 in. x 1/2 in., three sizes of bulb angle section material, 1/2 in. x 1/2 in., 1/2 in. x 1/2 in., and 1/2 in. x 1/2 in. are used. The channel sections are three in number, 1/2 in. x 1/2 in., and 1/2 in. x 1/2 in. Two 1/2 in. x 1/2 in. formed by extrusion are used for the after part of the keel and two extruded plate angles are employed for the keelson. The top and side plating of the hull is 0.030 steel, while the bottom plating forward of the step is 0.064 and aft of the step is 0.040. Two sizes of rivets are used in the hull: 1/2 in. and 3/8 in. and top plating and 3/8 in. in bottom.

plating. Stowing is relatively easy on account of the open section material employed. Forgings are used for rivet ends at the points of wing attachment.

The mooring pendant is $\frac{1}{2}$ in. diameter laminar cable attached to the hull at bulkhead No. 1, and the anchor cable, which is 150 ft. in length, is $\frac{1}{2}$ in. diameter laminar and is equipped with fittings at 25 ft. intervals by which the pendant can be attached. A cork canvas covered buoyage pad is rigidly attached to the nose.

STABILIZING FLAPS. These center flaps are located about 14 ft. from that of the hull, are structurally similar to the hull and each is divided into three water tight compartments by means of bulkheads. An internal lattice of these flaps is that they have no bracing plates. Each compartment is fitted with a 2 in. tube running from the bottom to a port 13 in. above the deck. A hose may be attached to the venting pipes, making it possible to pump up the compartments individually.

Right and left flaps are interchangeable and are attached to struts projecting from either side of the hull and also providing a point of support for the external bracing struts of the wing. Thus the bracing system is so tied into the external wing bracing that, while the overall span is large, the continuing at the wing tips is less than 1½ chord lengths. Each flap is held in place by means of eight studs and can be easily and quickly removed without disturbing the wing bracing. The ends of the projecting struts are squared to provide bearing area for the flaps and squared ends are filled with cork and painted to provide water tightness.

THE CARGO IS 8 ft. 3 in. wide and has 6 ft. head room. The hull is entered through a hatch on the deck and is divided into several compartments. The subdivision furthest aft, which is directly accessible by means of the emergency ladder from the launch, is devoted mainly to fuel; one compartment being provided on each side of the emergency ladder, and the combined capacity of the two being 125 cu ft. Sliding hatch covers are also built into the sides of the hull to facilitate loading of mail. The capacity of the two rear compartments is 200 cu ft. All bulkheads aft of the entrance compartment are fitted with apertures through which it is possible to gain access to the tail post for inspection.

Forward of the apex are three passenger compartments, each 73 ft. in, providing a total capacity of twenty persons. There are three windows in the outer wall of each compartment and these windows are permanently closed. Ventilation is provided by circular openings with semi-circular air scoops on the outer surface of the hull. Provision to vary the area of the openings is made through the use of an externally mounted, radial air-scoop controlled by a shaft having a levered knob in the cabin. There are two inlet and two outlet openings in each compartment, two in the deck and the other two in the side plating of the hull. The ventilators for the forward portion of each compartment open toward the rear and provide suction, drawing the air from the compartment, while those at the rear open forward, furnishing an inlet for fresh air. In order to prevent drafts the rear current of air passes between the skin or plating of the hull and the interior lining of the compartment.

The compartment just forward of the entrance compartment is furnished with two single seats and two daybeds, one of these being on either side of the center

aisle. Forward of this compartment are two others, each of which has double seats facing each other on both sides of the aisle, providing a capacity of eight passengers per compartment. Forward of these is a division in the hull, the port side of which is devoted to a washroom and radio room, while the starboard provides an additional outfit or baggage compartment of 73 cu ft. capacity. This division is separated from the control cockpit through a water tight door which can be opened from either side.

With this interior arrangement the boat has a capacity of 20 persons. Additional passenger capacity can be provided, however, by utilizing one or more of the mail compartments.

The first Compartment was outstanding in interior finish and design, the decoration being under the direction of Frederick J. Pike, a Buffalo interior decorator. A modernistic motif was developed by Mr. Pike through suggestion of the tropical colors that were to be seen along the route over which the plane is to operate. The basic tones are silver, brown and green. The outer walls, as well as the partitions, are of well-finished covered with damask, while a separate material is used as draperies with still other fabrics for upholstering of the seats and cushions.

The walls of the salon de luxe (the compartment containing the daybeds) are covered with a Decorette rug material of pale lavender and silver, the daybeds being upholstered in turquoise damask and the seat cushions in raspberry, gold and tan stripe material. Potted draperies in lemon yellow and tan have been used. In order to provide an individualistic color scheme for each cabin the central compartment has walls in green and gold with a brown ether damask drapery for seat cushions. The forward cabin has chairs upholstered in a green weave, while a modernistic fabric in peach and silver is



Photograph showing the main control compartment of the boat.

used for the cushions. Tan damask is used for the wall coverings. The control compartment through the compartments is carpeted with a pale green rug, while rights between the seats in the cabins correspond to the color scheme of the room.

Between the seats and under the windows in each of the passenger compartments are panels for maps, tables, magazines or newspapers. Adjustable card or writing tables can be fitted into appropriate seats in the same manner as that employed in Pullman cars.

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A photograph of the Commodore boat on the water during one of its trial trips.

Exterior finish also was specially attractive in the first Commodore. A series wing with yellow and brown hull was chosen to harmonize best with a tropical setting.

IN THE FIRST PLANE the control cockpit was open but was later enclosed to provide protection for the plane against weather conditions in the tropics. Both top and sides open by sliding to provide entrance to the control compartment without passing through the cabin. The pilots are seated in the bow just behind an anchor compartment as the nose which is accessible through a hatch in the deck and separated from the pilot's compartment by a bulkhead. Covered in all of the standard wheel and pedal type, a single steering wheel being used. All movable steel parts in the cockpit are made of Aluminum alloy. Cabins are used for the most part in the control system with a combination of these in push pull tubes being used for the ailerons. Tail surface structures are built up of extruded 17-757 alloy, drag braces and sheet aluminum ribs and are covered with fabric. An externally braced monoplane stabilizer, single unbalanced elevator and twin fin and balanced rudders above the stabilizer and elevator are employed.

The rudder travel is 30 deg. each side of neutral position, while the elevator travel is 30 deg. up and 20 deg. down. Travel of the rudder pedal is 4 in. either side of neutral, while the neutral position is 1½ in. forward of the vertical. An adjustment range of 3 in. is provided for the rudder pedal. The travel of the control column is 40 deg. to 18 in. Neutral setting of the stabilizer is at 4 deg. incidence, while an adjustment range of 8 deg. up and 2 deg. down is provided.

The area of the two rudders including the balancer is 40.2 sq. ft., while that of the balancer on each rudder is 3.3 sq. ft. The total vertical area of the tail surfaces is 34.95 sq. ft., while the center lower fin is 14.75 sq. ft. The total horizontal area is 135.5 sq. ft., 81 sq. ft. of which constitutes the stabilizer. Fin and rudder are built with a 30 per cent Göttingen section.

THE ENGINE motors are of welded steel tubing and rubber bushings are used around the engine bolts to absorb vibration. These blades metal propellers of approximately 9 ft. 6 in. in diameter are used on the forward engine and an exhaust manifold having a hot air stove and control box for interior heating purposes is also employed. Controls for the power plant, as well as the fuel system, are laid through streamline fairings to the pilot's cockpit and auxiliary gasoline tanks are so installed in the hull if desirable. The port engine is provided with a 50 ampere generator while the starboard an 80 ampere hour Willard storage battery, coordinates

the electric generating system. The storage battery is installed in the stern compartment from which the electric system is controlled. A voltage regulator is also used in the system and is located in the radio compartment. Provision for mounting landing lights on the leading edge of the wing structure also has been made.

Each Commodore is provided with a landing truck to be used when the plane is on land for overhauling. This truck provides mounting for two 44 in. x 30 in. wheels forward and one tail wheel.

Specifications as furnished by the manufacturer are:

Type	Monoplane Flying boat
Span	300 ft.
Overall Length	61 ft. 6 in.
Overall Height	14 ft. 2 in.
Wing Area	Göttingen 358
Chord	11 ft. 6 in.
Landings	-4 deg.
Decalage	2 deg.
Ailerons	Free Type
Tail Aileron (Fin and Rudder)	50 per cent Göttingen
Fin Setting	0 deg.
Incidence of Stabilizer	+4 deg.
Stabilizer Adjustment	+25 deg. in flight
Top Wing Area, Incl. Ailerons	3110 sq. ft.
Center Section	257 sq. ft.
Wing Panels (2) Incl. Ailerons	302 sq. ft.
Top Aileron Area Aft of Engine	110 sq. ft.
Tail Vertical Tail Area	50.95 sq. ft.
Center Lower Fin	14.75 sq. ft.
Rudders (2) Incl. Balancer	40.2 sq. ft.
Balancer on Each Rudder	3.3 sq. ft.
Total Horizontal Tail Area	135.5 sq. ft.
Stabilizer	81 sq. ft.
Elevator	54.5 sq. ft.
Useful Load	7915 lb.
Crew—Pilot, Mechanic	340 lbs.
Pass and Oil	2025 lb.
Ribs	180 lb.
Pay Load	5270 lb.
Passengers (30 @ 170 lb.)	5100 lb.
Mail and Baggage	1870 lb.
Weight Empty Structure	6795 lb.
Power Plant Complete	5590 lb.
Front Equipment	2250 lb.
Gross Weight	17,000 lb.
Wing Loading	15.6 lb. per sq. ft.
Power Loading	15.3 lb. per hp.

SOME GLIMPSES AT THE CONSTRUCTION OF THE *Consolidated "Commodore"*



Above: The cut away of the Commodore showing the main cabin window structure (left) and the main cabin window (right). The structure shows the attachment in the tail.



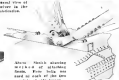
Left: Detail of the main cabin window structure, showing the internal framework and the window opening.



Above: Main cabin window structure of the Commodore (left) and the main cabin window (right). The structure shows the attachment in the tail.



Above: A general view of the main cabin window structure of the Commodore.



Above: Main cabin window structure of the Commodore (left) and the main cabin window (right). The structure shows the attachment in the tail.



Above: A view up of the main cabin window structure of the Commodore. One of the main cabin windows can be seen. The structure shows the attachment in the tail.



Right: Detail of the main cabin window structure of the Commodore.



Above: One of the main cabin window structures of the Commodore.



Above: One of the main cabin window structures of the Commodore.



Left: Applied view of the main cabin window structure of the Commodore.



Above: Method of attaching the main cabin window structure of the Commodore.



Above: One of the main cabin window structures of the Commodore. The structure shows the attachment in the tail.



Below: One of the main cabin window structures of the Commodore.



Right: The completed main cabin window structure of the Commodore.

SURVEYING THE Airport IN NEW YORK CITY Problem



The black squares directly coloring airplane landing fields. The circles represent proposed airplane landing fields. The squares indicate and proposed possible landing fields.

By JOHN C. HOLME, JR.

THE SCUM and substance of the airport problem in every large city in the world is present in an exaggerated degree in New York City.

The metropolitan area provides many aviation terminals, but none of them offers adequate facilities for air transport service in which every consideration of the air traveler is met.

Despite the abundance of waterways within the metropolitan area and its five boroughs, and the level character of the surrounding topography, offering suitable airport sites, New York City and environs possess no ports justifying the Department of Commerce Class "A" rating, and the same time within 20 minutes of the center of population.

Although a number of both land and sea airport projects are under way and probably will be completed within a year, New York City still does not possess the aerial terminal facilities offered by many smaller cities. The tremendous increase in population, combined with

the natural features of the city's configuration, offers some excuse for this unfortunate situation.

No aviation terminal comparable to the rail center terminal such as the Grand Central and Pennsylvania Stations can be planned

for New York because the special requirements of speed and convenience associated with air travel and an unreasonable consideration in it, must be met by distribution of airports for the convenience of each separate center of population. Therefore, any city with as many (popular "islands") (in use as a not very responsible political term) as New York, must, perforce have an airport for each individual "island." Moreover, it is desirable and necessary that the various terminals be widely separated in order that they will not all be subjected to the same weather conditions simultaneously.

The subject of airport development is and about New York metropolitan area should therefore be regarded as a problem in co-ordination, rather than in the development of facilities now principally distinguished by their subspecialty.

In 1927, the problem, brought to public notice by aviationists, visiting flyers, intelligent enthusiasts, and foreign-born citizens was responsible for the appointment of the Fast-Flying Committee of Suitable Airport Facilities for the New York Metropolitan District.

President Hoover, then Secretary of Commerce, appointed Hon. William P. MacCracken, Jr., to organize this committee, which consisted of 24 members representing the federal and local governments, as well as "The commercial and non-commercial interests concerned."

In addition to its executive sub-committee, four sub-committees were chosen to consider location, engineering, valuation, and ways and means. In examining possible sites, the committee took five major points into consid-

eration. 1. Accessibility. 2. Size, shape and approach. 3. Suitability from the meteorological point of view. 4. Present value of property. 5. Cost of preparing site for initial development.

As a result of these investigations and in view of the fact that as many excellent sites were found available, it was decided that sites recommended for major airports by this committee must, as well the Department of Commerce Class "A" requirements, and unless for some exceptional reason, must be within the 30-minute zone of rapid transit travel time to and from transportation



The facilities with suitable airport facilities as approved by the Fast-Flying Committee

New York's airport problem is of more than local interest. The whole nation is concerned with the transportation facilities of the nation's largest cities. The present article summarizes the background of airport requirements for the New York area. It will be followed by two others describing the present and proposed facilities for land planes and seaplanes, respectively. Mr. Holme shows how the problem has developed, and compares the recommendations of various committees that have surveyed New York's Airport requirements.

concluded in Manhattan and most efficient development of airplane facilities.

A survey of meteorological conditions in the metropolitan district has been made and may be summarized briefly as follows: there is practically no variation in either the general wind conditions or precipitation throughout the district nor in the total number of advection fogs (including both light and dense fogs of one hour duration or longer). However, the occurrence of drizzle fog (fog that obscures objects 1,000 ft. away) decreases very rapidly from the southern to northern portions of the district and slightly from the eastern to western portion. The records of the Weather Bureau show that dense fog occurs at Sandy Hook seven per cent of the days of the year, at the Battery, six per cent; at Central Park two per cent, at Mount Vernon, one per cent. The presence of radiation fog (ground frost) varies but slightly throughout the district, any one of the low flat areas being about as subject to fog as any other. Most of the radiation fog in the district originates west of Manhattan and is carried over the city by prevailing westerly winds. In general, the density of this smoke decreases from the southern to the northern portion.

At the time the Fast-Flying Committee made its preliminary survey the metropolitan district contained three major military fields, Mitchell Field, Miller Field, and Roosevelt Field, and four minor commercial airports, Hadley Field, Teterboro Airport, Cresskill Field and Roseton Field. In addition, there were a number of others mostly unimproved, from which a certain amount of commercial and private flying has been carried on, and several which are clustered in suburban fields suitable for emergency use. There were two of these unimproved or emergency fields within a 25-mile radius from central Manhattan.

In its report, the committee divided the district into six general locations, as follows: 1. Queens-Flushing Bay Area; 2. Newark Bay Area; 3. Bronx-East River Area; 4. Hackensack Meadowlands Area; 5. Jamaica Bay Area; 6. Westchester-Briarcliff Area.

Two sites were recommended as first and second choice

landings for additional development in these two areas.

First choice for the Queens-Flushing Bay Area is No. 18 on the accompanying map of recommended airport sites, the Juncos Valley site.

The first involved in transportation from Times Square, viewed as a hoped-for starting point to most airports in the metropolitan area, is reported in this and succeeding articles—an approximately accurate figure based upon actual test by the writer under actual traffic conditions. It is therefore fair to the airports to consider traffic congestion in New York City as operating against the express purpose of aircraft-to-speed transportation. It will be readily seen that these estimates will vary considerably depending upon where the start is made. From Wall Street to Long Island ports of New Jersey, and to Westchester County, offers much more of a problem than when one starts from the Grand Central or Pennsylvania station districts.

It is thence thence from the Pennsylvania Station to the Long Island Railroad's proposed station at Rego Park, the terminal for Site 61. Second choice for this location is Site 23, due west of College Point and adjacent to the Whitehouse Branch of the Long Island Railroad.

There are now three airports in this area. Johnson, under construction, North Beach, and a third, with proposals for the development of an adjacent airport and New York City Airport with surplus accommodations, under construction on Site 22.

Is there New York Bay sites, Site 2 (see map), recommended by the Committee, has also been brought to the actual form as New York's Metropolitan Airport Provision for the ultimate enlargement and development of sea-plane facilities has been provided for by the City of New York, owners of the Municipal port.

For a location in the Bronx-East River Area, Site 19, east of the Harlem Division of the M. V. & N. R. R. Hartford Railroad, has since been adopted in a proposed Census Airport.

Site 2, second choice, on the north bank of the East River, is near Old Ferry Point. There is apparently no suitable information or proposals for the development of this latter site.

A site northeast of Secaucus, is recommended as first choice for the Hackensack Meadows District and Site 4, northeast of Secaucus, bounded on the west by the Hackensack River and on the south by the first railroad is second choice. The latter Secaucus site is now under construction for New York Air Terminal, Inc.

An first choice in the Jamaica Bay Area is a tract of city-owned marsh land located on the proposed East Island of the Jamaica Bay project, was recommended but has been definitely rejected by Borough President Harvey as being too far from transportation facilities. Site 26, a city-owned tract, on the westerly shore of Jamaica Bay, north of Barren Island, and bounded on the southwest by Flushing Avenue, was recommended by the Committee and is now under construction at the Floyd Hovest Municipal Airport. It will be supplemented by a single channel to Jamaica Bay.

Site 7, Governor's Island, is said for the Wall Street-Brooklyn Area, but negotiations with the War Department for the development of this site for other purposes or for landings have repeatedly failed at their object.

Co-ordination and development of airplanes in and about New York was also one of the major considerations of the experts who prepared the Regional Plan for New York and its Environs. This Plan, completed in 1929,

is the result of seven years of research carried out under the direction of the Russell Sage Foundation at a cost of \$1,000,000. Broadly, it covers all phases of traffic and transportation problems, as well as recreation and health centers, land regulation and protection, and other questions incident to furnishing adequate provision for a population of 20,000,000 in the metropolitan district.

So far as airport development is concerned, the Sage Foundation report goes further than the report of the Joint-Paving Committee in that it devotes more attention to the planning of airport sites in relation to proposed as well as existing rapid-transit facilities. The Sage Foundation report points out that accessibility in the largest prior consideration, because the abundance of highways will far limit in the distance provides almost unnumberable possible sites. However, topography, freedom from obstruction and clarity of atmosphere have also received due consideration.

The Regional Plan therefore includes a summary of airport system proposals from which the following question, is taken:

"In ten years about 22 landing fields have been constructed in the Region in connection with air transportation. (1) ten of which are considered, 3 primary, 2 secondary and 2 auxiliary fields). However, 'development of service in Italy to be longer term as a mode of the absence of provision that it is by difficulties in perfecting the airplane itself. . . . There must be an intrinsic relation of airport terminals to population density because the ease made of air transportation for passengers the extent which will make it economically feasible or otherwise, will depend largely upon the rapidly with which the largest number of people can reach their destination."

In addition to the airports already acquired or in the course of construction, it is suggested in the following additional areas should be acquired in the near future:

1. Area comprising the marshlands in the Southern part of Bronx.
2. Development of a major airport in the southern part of the Borough of Queens in a site readily accessible from Manhattan.
3. Development of an airport adjoining Pelham Bay Park.
4. Development of Governor's Island as a major military landing field with privileges, if possible, for the accommodation of commercial transportation by air.

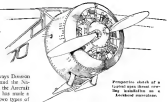
It is interesting to note that in fact, barely two years after the publication of the report of the Joint-Paving Committee, five airports are under construction on the recommended sites in the six districts, three additional landing areas are being developed in the areas mentioned, whereas to, but other than on recommended sites. Two of the sites have been definitely rejected, and present needs have not yet pushed development of the other three.

The publication of the Regional Plan, is too recent to have had very much practical effect as yet, but it offers an excellent basis for present co-ordination of airport development adequate for the needs of the New York District—and it will undoubtedly be given serious consideration in the planning of all further projects for air transport facilities.

THE Shielding Effect OF N.A.C.A. COWLINGS

By F. H. DRAKE
and A. W. PARKER, JR.

Through Division
Radio Frequency Laboratories, Inc.



AT THE INVITATION of the Airways Division of the Department of Commerce and the National Advisory Committee for Aeronautics, the Aircraft Division of Radio Frequency Laboratories has made a comparative investigation of the effect of two types of N.A.C.A. metal engine cowling in reducing interference with radio reception on airplanes. These two cowlings will be subsequently termed the "Lowest" and "Open Throat" types. The Open Throat N.A.C.A. cowling, as its name indicates, offers to the air which has been induced to flow smoothly around the cylinders and a passage back along the fuselage through an open throat, and is the type of cowling commonly known through its efficiency in decreasing the parasite drag on the motor. The

Lowest N.A.C.A. cowling has, in place of an open throat, a number of inlets in the rear section of the cowling for egress of the air from about the cylinders. Although this issue recent type of cowling has not yet proved as efficient in decreasing the parasite drag as the earlier open throat type, its numerous fuel conditions that it can with slight modifications, be made practically as effective in this respect.

There much type of cowling consists essentially of a grounded sheet-metal cylinder around the periphery of the engine, whose reduction in the engine interference with radio reception on the plane would naturally be expected from its use. It was to investigate this effect that the following experiments were made.

A radio receiver of high accuracy sensitivity and calibrated for microwave measuring ("Microwave standard") is defined as the number of receivers of radio frequency range (modulated 30 per cent at 400 cycles) required in a standard 100 watt noninterference antenna to produce 15 v. r.m.s. radio volts across a 6,000 ohm pure resistance (resistor load) against the pattern of the pure control at a wave length of 100 m., was measured on a small truck along with a 6 ft. vertical antenna and necessary batteries. The metal floor of the truck served as ground. For various conditions and types of cowling as a Stearns engine (Wright Whirlwind Engine) and as a Corbin engine (Wright Whirlwind Engine) the relative interference measurements at three positions about the plane was determined by facing the point in which the maximum interference of the motor had to be reduced to make the section interference just audible. The interference ratios for various positions and conditions of cowling are then directly as the corresponding permissible re-



Apparatus for quantitative measurement
of open throat interference

cover sensitivities than a fixed, air interference mine of unity at a constant position means that a receiver with a minimum sensitivity of 20, used in air position with a constant antenna having an effective height of one meter, will be capable of just hearing the specified disturbance. Better ground than sea is indicated correspondingly higher sensitivity interference levels. The figure of 10 minimum sensitivity, upon which these minima are based, is a fair average figure of the maximum sensitivity of modern radiotele commercial aircraft receivers, hence interference ratios greater than unity definitely limit the service range of such receivers.

The positions about the plane at which tests were made are indicated in Fig. 1. Although in service one would

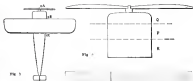


Fig. 1



Fig. 2: A photograph showing a person standing next to a large, complex, multi-lobed antenna structure, likely the 'Leavitt' type of covering model mentioned in the text.

never want to place an antenna at position A nevertheless the readings obtained here serve as a qualitative check on the readings at the other positions.

In Fig. 2 is a single antenna for the various sections of the Leavitt covering. Section B contains the Leavitt. The Open Transmitter is built in one large antenna somewhat larger in diameter than the Leavitt covering to permit the test to pass out at the back.

The Sherman plane was completely shielded except as specified above, that is, all inspection, low and high tension leads and ignition switch were completely shielded by metal containers.

In order to determine what reduction in ground interference would result from the use of the regular open-transmitter covering on an otherwise unshielded engine, tests were made on a Curtiss Hawk with a Whisp engine. Results are shown in Table II.

Position C of the measuring apparatus is a condition which corresponds roughly to operating conditions using a coil antenna on an open airplane. Previous experience with service installations on single-engine planes having a coil antenna at this position has indicated a figure of the order of 6000 increments for the sensitivity of a commercial receiver at which the ground interference is just audible with no shielding whatever. This is consistent with the figure 5000 (sensitivity 5000 increments) no coded and/or confusion C and with no shielding in the present experiments.

From the above sets of data certain general conclusions

may be made. In the first place, it is apparent from the results on the unshielded engine that the use of the regular open-transmitter covering on its own causes a substantial general shielding of the ignition system. Although the 'Leavitt' type of covering would doubtless shield con-

Table II—Curtiss Hawk, Whisp Engine		
Condition of Covering	Interference Ratio	
Open circuit	1	1
Open Transmitter antenna	1,400	1,400
Whisp engine	3,300	2,300
Whisp engine at 100 ft	3,300	2,300

siderably more, there is little reason to hope in the light of the other data above, that even this will provide adequate suppression of the ignition interference.

The only advantage from a radio standpoint in the use of the NACA covering appears to be in the possibility of getting along without shielded spark plugs with the Leavitt type of covering but with an otherwise completely shielded ignition system. This advantage from the use of the covering is by no means unimportant.

CONSTRUCTION OF *Airfoil Sections AND* *Wing Generation*

*The First of Two Articles on a Systematic Method of
Designing Airfoils*

By JEAN FRADIES and ARMAND THIEBLOT

IN PREVIOUS ARTICLES (*Analysis of the Wing*) we have seen that the selection of an airfoil section is governed by the choice of certain coefficients or characteristics. The purpose of this paper is to give a means of designing, or constructing graphically, an airfoil section having certain desired characteristics. The method which leads to this result allows the engineer to replace research at random, which as far has been of worthless use, by a systematic and rational investigation.

Two problems are involved: The construction of theoretical airfoil sections, and the generation of wings by variation of an airfoil along the span.

These problems which pertain to advanced wing theory and aerodynamics are naturally very complicated, and the few authors who have treated these questions have always dealt much more with the theoretical side data with the practical aspect of it. The most important and important theory of airfoil sections and wing theory which has been developed only in the last few years is yet little known.

Our purpose is to give every aeronautical engineer a method of designing his own airfoil sections and wing to suit his ship which does not involve tedious and analytic geometry, despite the fact that they are necessary for a rigorous proof of the method.

These articles will contain two parts: first, we have tried to present in a few pages a very much simplified and unadorned outline of the method of construction of theoretical airfoils and wings without any mathematical development or detail, for this can be found in several works, to which we refer below. The first part is given only for reference and explanation for the second part and the reader who is interested in aerodynamics.

In the second part we shall present the practical method of graphical construction of theoretical airfoils and wings.

The theory of wing section, suggested by Lanchester

and Joukowski who give the expression of the lift coefficient for an airfoil section moving in a perfect fluid and having an infinite span, was subsequently developed by Prof. von Mises in Germany and Mears, Tisserand and Canada in France.

The theory of Prandtl gives a means of interpreting the theory for wings of finite span.

THE essence of the investigation is to obtain, for any particular case, an airfoil section superior to any found in the tables, or determined by the 'test and try' method.

This does not mean that the first airfoil constructed will necessarily be more satisfactory than any other, but it means that by replacing research at random, by a systematic study of the variation of the characteristics with certain coefficients of the airfoil one is sure to reach a better result—in fact which is obvious and has been proven by experience.

Certain properties of airfoils designed according to the following method are known in advance and without any tested test, namely: moment coefficient, pressure distribution, location of the focus, location of line of zero lift, etc.

In fact it is possible to give to the airfoil any moment coefficient of course as a function of the other characteristics.

In a wing generated as described below, the arbitrary variation of the characteristics of the airfoil section is replaced by an aerodynamic variation. The principal advantages are: generally a better known ratio and a more efficient wing, the exact knowledge of the lift distribution, the location of the center of pressure of the moment coefficient, of the optimum angle of the airfoil section along the span.

It is possible to choose in advance the resultant moment coefficient of the wing and the law of variation of this

coefficient along the span. For instance, if instead of being constant it is smaller at the tip and higher at the root, the resultant forces on the wing is decreased.

This is very important especially for wings of the aircraft type not subject to reduced income but also in calculating the degree of wing taper.

The appearance of this phenomenon is not solely dependent upon the actual strength of the wing—in other words, wing taper cannot always be eliminated by an increase of strength. The degree of wing taper stresses within:

1. The center of pressure travel

2. The fact that the crossing angle of attack is near to the angle of zero lift

3. The lack of torsional rigidity

Therefore, in designing a wing a small moment coefficient and a small center of pressure travel will show the greatest coefficient decreasing from the root to the tip for both the centerline and the semi-centerline type.

In the center section a slightly higher moment coefficient may be used as account of the great resistant aerodynamic characteristics, because the deformation of the wing near the fuselage structure is always comparatively small. But at the wing tip, as the aerodynamic section with a small displacement of the center of pressure will be small. Another important feature of a wing with a small moment coefficient is their great inherent stability.

So far as strength of materials is concerned, the decrease of the torsional moment is not the only advantage; for instance, a periodic variation of the thickness along the span allows the construction of spars of uniform strength.

The relative incidence of the different airfoil sections, i.e., the law of variation of the incidence along the span, is determined in such a way that each section, for example, is at its angle of maximum drag or of maximum fineness ratio for a given angle of attack (for the mean section, for instance). This relative incidence should depend upon the purpose of the ship, but it seems that the most advantageous way is the one corresponding to the zero lift incidence. We recommend this meaning for the following reasons:

1. The calculations are easier

2. The balance of the airplane is easier because in this case the location of the focus of the section and the resultant focus of the wing are known, and the location of the focus determines the location of the center of gravity of the airplane.

In a previous article the focus of an airfoil section has been defined as a point of the plane of the section such that the aerodynamic forces acting on the section can be resolved with respect to this point into a force equal to the lift and a couple constant with the incidence. (This constant couple is equal to the moment coefficient with respect to the focus at zero lift; K_{M0} .)

The couple of the resultant of the forces acting on the wing being constant with respect to the focus of this wing, if the center of gravity of the airplane is located on the vertical passing through the focus of the wing (considered to be at the angle of attack corresponding to zero lift at cruising speed), and if we assume that the couple due to the tail is proportional to the angle of attack, the total couple acting on the plane will be pro-

portional to the angle between the actual position and normal position of flight.

If all the external forces acting on the airplane are resolved with respect to the focus of the wing, and not with respect to the center of gravity of the airplane as is generally done, it is possible to put in a single mathematical form the equations of the static stability of the ship.

Therefore the study of balance and static stability of an airplane having a wing determined this way may be carried out in full without any tunnel test.

3. The setting of the airfoil section at the location corresponding to zero lift has another important feature. Let us suppose that, at the position of zero lift for the wing, the section has any relative incidence, the general resultant of the lift is equal to zero while some sections have a positive lift and others a negative lift. Therefore in certain cases of flight, such as dive, load heading stresses will be added to the normal torsional stresses, thus creating additional stresses in the members. The magnitude of these stresses may be considerably and particularly hard to determine. Furthermore, the efficiency of such a wing is low. This setting may also cause failure.

ANOTHER CHARACTERISTIC of a wing with the section set at zero lift is a great fineness ratio at the angles for which K_{M0} is small.

Therefore on the one hand the problem consists of designing an airfoil section (generally the outer section) in such a way that this section has certain aerodynamic characteristics and reducing the other sections following a continuous and decreasing law, by varying the chord, K_{M0} , the thickness ratio or any other geometric or aerodynamic characteristics of the airfoil section, from the root to the tip.

Wings designed in this manner have a thick airfoil at the root and are thinned at the tips. They are also tapered in plan form.

The advantages of such a wing over a wing with a constant airfoil section are well known.

Nevertheless, for the purpose of wing design, we will note the following differences between thin and thick airfoils.

The thick airfoils have a greater lift than the thin airfoils, because they have generally more camber at the camberline.

The zero lift for thick airfoils occurs at smaller angles and the maximum lift at larger angles than for thin sections.

The maximum drag is generally greater for thick sections than for thin sections, but increases less rapidly with the angle of attack. With the method described below it is possible to reduce the K_{M0} of thick sections to the values obtained by the best thin sections.

The center of pressure is generally located further forward for flat-bottomed or in particular bow-shaped thick sections, and the center of pressure travel is smaller than for the sections with a concave lower camber. A wing having a moderate camber smaller at the center section has a better efficiency at high speed and is more stable.

A thick airfoil generally has no handle point at a greater angle of attack than the thin airfoils. Therefore the thick sections have better characteristics at high angles.

The investigation of the pressure distribution that will be given below shows that the center of pressure travel is proportionately smaller near the center of a tapered

wing than near the tips; the consequence of this phenomenon is that the center of pressure travel for the total wing is practically independent of the taper in plan form.

The aerodynamic characteristics of a family of airfoils depends very upon the mean thickness ratio than upon the taper in thickness ratio. The efficiency of thick wings tapered at the tip is always higher than that of a wing of rectangular plan form and of constant section in addition to increased aerodynamic efficiency the use of thick wings also permits a lighter structure.

Résumé of the Theory of the Wing Section

IF THIS THEORY the air is considered as a continuous homogeneous medium, non-viscous and incompressible, that is, as a perfect fluid.

The motion is assumed to be in a plane (two-dimensional motion) and to be irrotational, that is, if we consider any small parallelogram the fluid in angular velocity is equal to zero.

The theory of the airfoil section is based upon the determination of the velocity at all points of the fluid in which the airfoil section is moving. When the distribution of the velocity in the fluid is known, the distribution of pressure is also known from Bernoulli's equation ($P + \text{constant} = \frac{1}{2} \rho v^2$) but it is quite im-

possible to determine directly by means of mathematical procedure the velocity at any point on any given airfoil section. This determination can be made only for sections of elementary form and is generally made by line and circle¹ sections.

The application of the property of the analytic function gives a means of transforming the velocity distribution around a circle into the velocity distribution around an airfoil determined from the circle by a certain function of transformation.

First Part: A Circle

THE VELOCITY is expressed in terms of u and v , its components respectively along the coordinate axes ox and oy , or, being parallel to the direction of the potential motion of the fluid.

It is shown in hydrodynamics that when the motion is irrotational, there exists a certain function ψ (x, y) such that its derivatives for a given point with respect to the co-ordinates give the projections of the velocity of the fluid at this point upon the axes of co-ordinates considered, that is:

$$u = \frac{\partial \psi}{\partial x}, \quad v = \frac{\partial \psi}{\partial y}$$

This function is called the velocity potential. The velocity at each point of the fluid can be represented by a vector. A flow drawn in such a manner that the velocity vector is tangent to this has at every point along its length is called a stream line, and a series of such lines give a graphical representation of the flow.

The differential equation of a stream line is obtained by writing that the projection of a small element $d\mathbf{s}$ of this line is perpendicular to the projection of the velocity.

$$\frac{dy}{dx} = \frac{v}{u} \quad \text{or} \quad u dy - v dx = 0$$

Let $d\psi = u dx + v dy$ then $d\psi = 0$ and $\psi = \text{constant}$ $\psi = C$ represents therefore a stream line and

the flow past any body is conveniently obtained, when knowing the function ψ , a series of values is given to the constant C .

The function ψ is called the stream function and represents the quantity of fluid which flows between two adjacent stream lines. Referring to Fig. 3 let AB and CD be any two adjacent stream lines. Since by definition there is no flow across a stream line, the flow across AB is equal to the flow across CD plus the flow across AC . Then, if $d\psi$ is the flow across AB ,

$$d\psi = u dy - v dx$$

which is a function of x and y , $d\psi$ may also be written

$$d\psi = \frac{\partial \psi}{\partial x} dx + \frac{\partial \psi}{\partial y} dy$$

or

$$u = \frac{\partial \psi}{\partial y} \quad \text{and} \quad v = -\frac{\partial \psi}{\partial x}$$

The projection of the velocity can be expressed by the stream function as well as by the velocity potential:

$$u = \frac{\partial \psi}{\partial y} \quad v = \frac{\partial \psi}{\partial x} \quad \text{or} \quad v = -\frac{\partial \psi}{\partial x} \quad (1)$$

The flow past a circle is conveniently expressed in terms of the stream function. As indicated above this function represents the stream line of the flow, therefore, in the present case this function must be determined so that for a certain value of the constant C , the corresponding stream line is the circle considered—and when the value of the constant increases the stream lines become straight lines parallel to the axis ox (the method of images by consideration of sources and sinks² obtains the establishment of the stream function for the flow past a circle. These considerations are rather more than a pure mathematical procedure used to obtain a function having the above characteristics.

$$\text{Let} \quad \psi = -Uy \left(1 - \frac{a^2}{x^2 + y^2} \right)$$

be the stream function.

Where U is the projection of the velocity on the axis ox or u as y approaches infinity.

The stream line $\psi = 0$ is represented by

$$y \left(1 - \frac{a^2}{x^2 + y^2} \right) = 0$$

which gives the two stream lines $y = 0$

$$\text{and} \quad 1 - \frac{a^2}{x^2 + y^2} = 0 \quad \text{or} \quad x^2 + y^2 = a^2$$

which is the equation of a circle.

The stream lines for different values of ψ can be drawn easily and are shown in Fig. 4. From the stream function considered above it can be seen that the velocity distribution is symmetrical with respect to the axis ox , and therefore the pressure distribution, hence there is no resultant force perpendicular to ox acting on the cylinder having for its base the circle in question. In order to obtain an unsymmetrical distribution of the velocity, a second flow is superimposed on the first one. This flow is assumed to circulate around the circle, and

¹ "Elements of the circle section theory and wing theory by H. Glauert, *Aviation Progress* (H), National Aeronautics Administration, 1937, p. 100.

² "The method of images in hydrodynamics," by H. Glauert, *Aviation Progress* (H), National Aeronautics Administration, 1937, p. 100.

therefore it increases the velocity on one side and decreases it on the other.

The stream function corresponding to this flow is

$$\psi = -\frac{\Gamma}{2\pi k} \ln R.$$

This function is determined by the following conditions:

1. The radial velocity is zero.
2. The tangential velocity is constant, independent of angular position of the radius vector, and is inversely proportional to the radius.

The velocity along the tangent is given by:

$$\frac{\partial \psi}{\partial R} = v'$$

The velocity along the normal is:

$$\frac{1}{R} \frac{\partial \psi}{\partial \theta} = v''$$

then

$$\frac{\partial v'}{\partial r} = \frac{\Gamma}{2\pi k R^2} \quad \frac{1}{R} \frac{\partial v''}{\partial \theta} = 0 \quad (B)$$

The expression of the stream function is the integral form of the equation (A):

$$\psi = -\frac{\Gamma}{2\pi k} \ln R$$

The constant Γ , which is called the circulation, is found from equation (A):

$$v' = \frac{\partial \psi}{\partial R} = \frac{\Gamma}{2\pi k R}$$

$$\Gamma = v' 2\pi k R$$

Thus the circulation is equal to the product of the velocity by the length of the closed open line enclosing the circle. Hence the general expression for the stream function of the flow past a circle can be written

$$\psi = -U' y \left(1 - \frac{a^2}{R^2}\right) - \frac{\Gamma}{2\pi k} \ln R$$

The same flow can be expressed in terms of the velocity potential and has the following potential function:

$$\phi = -U' \left(1 + \frac{a^2}{R^2}\right) + \frac{\Gamma}{2\pi k} \theta$$

where

$$\theta = \tan^{-1} \frac{y}{x}$$

In a similar manner as for the stream function, lines of constant values of ϕ and corresponding series of lines may be drawn in the plane $x-y$. These lines are called equipotential lines.

The relations

$$\frac{\partial \phi}{\partial x} = \frac{\partial \psi}{\partial y} \quad \frac{\partial \phi}{\partial y} = -\frac{\partial \psi}{\partial x}$$

give

$$\frac{\partial \psi}{\partial x} \frac{\partial \psi}{\partial y} + \frac{\partial \psi}{\partial y} \frac{\partial \psi}{\partial x} = 0$$

by $\frac{\partial \psi}{\partial x}$, $\frac{\partial \psi}{\partial y}$ are proportional to the direction cosines of the

normals to the equipotential lines and $\frac{\partial \psi}{\partial x}$, $\frac{\partial \psi}{\partial y}$ are proportional to the direction cosines of the normals to the stream line, this relation shows that the equipotential lines intersect the stream lines at right angles. It is

shown in the theory of the functions of a complex variable that a function representing two curves intersecting at a certain angle in a given plane can be transformed into another plane in which the curves representing the families having a different locus intersect again at the same angle. This transformation is called conformal transformation. Hence, the family of equipotential and stream lines may be transformed from one plane to another, if it is possible to obtain the expression for these curves in terms of an analytic function.

While a rigorous mathematical demonstration of this fact lies outside the scope of this paper, it can easily be shown that the possibility exists of obtaining such an expression.

Let

$$F(Z) = W + iV$$

be a function of a complex variable $Z = x + iy$ (N and N' being two real functions of x and y , and $v = \sqrt{-1}$).

The derivative with respect to z gives

$$F'(Z) \frac{\partial Z}{\partial z} = F'(Z) = \frac{\partial W}{\partial x} + i \frac{\partial V}{\partial x}$$

and the derivative with respect to y

$$F'(Z) \frac{\partial Z}{\partial y} = i F'(Z) = \frac{\partial W}{\partial y} + i \frac{\partial V}{\partial y}$$

or multiplying by i we have since $F' = -1$,

$$F'(Z) = -\frac{\partial W}{\partial x} + \frac{\partial V}{\partial y}$$

consequently

$$\frac{\partial W}{\partial x} = \frac{\partial V}{\partial y} \quad \text{and} \quad \frac{\partial W}{\partial y} = -\frac{\partial V}{\partial x}$$

The same relation exists between N and N' as between the functions W and V , and therefore the real part of a function of a complex variable may represent the velocity potential and the imaginary part the stream function.

The complex function

$$w = \phi + i\psi = f(Z)$$

is called the potential function of the flow, when the complex variable $Z = x + iy$ describes the plane (as in the study of function of a complex variable) $f(Z)$ describes the equipotential and stream line of the flow.

We have seen that

$$\psi = -U' y \left(1 - \frac{a^2}{R^2}\right) - \frac{\Gamma}{2\pi k} \ln R$$

$$\text{and} \quad \phi = -U' \left(1 + \frac{a^2}{R^2}\right) + \frac{\Gamma}{2\pi k} \theta$$

$$\text{then} \quad w = F(Z) = -U' \left(x + \frac{a^2}{x}\right) - i \frac{\Gamma}{2\pi k} \ln Z$$

represents the potential function of the flow past a circle in terms of the complex variable Z .

The derivative of the potential function $f(Z)$

with respect to z gives

$$\frac{\partial f}{\partial z} = \frac{\partial \phi}{\partial x} + i \frac{\partial \psi}{\partial x} = \frac{\partial \phi}{\partial x} + i \frac{\partial \psi}{\partial x}$$

hence

$$\frac{\partial f}{\partial z} = \frac{\partial \phi}{\partial x} + i \frac{\partial \psi}{\partial x} = u + i v = w$$

which is called the complex velocity.

The derivative of the potential function with respect to the complex variable gives the proportions of the velocity in the two axes x and y .

A COMPARISON

of England's TWO NEW Airships

By AVIATION's
British
Correspondent

THE R. 101 England's second major airship to be completed within six months, was launched Dec. 16 at the Hawden airship base of the Airship Guarantee Co., from 148 m. to the Carlisle Royal Airship Works and then moved to the tower which until recently had been used constantly for the mooring and towing of the R. 101, a sister ship. A second flight followed the mooring trip, following which it was decided to leave the ship at Carlisle's other available mooring for a thorough study of the behavior of the envelope. The R. 101 had been returned to its hangar for general overhaul and to make room for the new arrival at the mooring mast. Commander Berry built the new airship.

The launching of this new airship once more has attracted wide spread interest to the lighter-than-air field, especially in the light of the recent performances of the R. 101, which has just completed its test and demonstration flights with a high degree of success. A description of the former inevitably involves comparisons with the latter.

This article must deal chiefly with the structural differences, however, since performance figures are lacking for R. 100, with the exception of those derived from the flight from Hawden to Cardington.

Such an unexpected and abrupt course of test flights pending construction of the ship's envelope serves to focus attention immediately on the situation which has cropped up there. Considering the general description of the new dirigible for the moment, we shall explain the nature of the trouble encountered, the circumstances under which it developed and the results.

It is necessary first to explain how the envelope is attached to the R. 100 in comparison with the method of R. 101, the State airship, which has given no trouble whatever and has ridden out gales of 33 mph at the westward. R. 101, it will be recalled, has flying wire longitudinal and an equal number of atmospheric reefing girders which serve not to keep the rear end, while the envelope is always subject to a constant pressure



The R. 101 moored at its mast at Carlisle after a successful 100 mile flight.

frass made by air from intakes at the nose and tail. Breathing grids underneath let out any excess over the desired positive pressure. The system has worked successfully and with 32 main and secondary longitudinals and the positive pressure the envelope has always remained smooth and stable, giving as perfect a streamline shape as can be desired. The disadvantages of this system is that the trailing gridlets add about four tons to the structural weight.

R-100 is not fitted with these trailing gridlets. Thus the envelope, stretched over the entire longitudinals, presents flat surfaces. In order to stabilize the envelope it is drawn inward by a series of circumferential wire rings at 1-ft intervals inside the ship. These circumferentials cause the envelope to be convex between each set of longitudinals. The envelope and wire ring thus make two concave arcs between each set of gridlets and this in theory should make the envelope inherently stable. Instead of providing internal pressure, it has been arranged for air to enter and pass out of the envelope through large vanes on the under side of the ship so that the concave arc be as far as possible in balance against dynamic lift forces.

The natural outward action over a streamline shape apparently is relied upon to help maintain the concave arc in flight and this system of it proves sound, but, of course, the want of being much lighter than that of R-101. But when the ship appeared over Conington on her maiden flight the condition of the envelope at once attracted attention and aroused some concern. Instead of

being smooth and almost a true circle as in R-101, the concave arc pulled straight where the air points nearest the outward surface. Some pits were more noticeable than others suggesting that intakes were clogged. There was definite sagging of the envelope at certain points, especially where the alternators from the side cars are mounted on the envelope, and the lower nose fin, which is in the depression of the nose engine air, obviously needed straightening.

The whole fabric of the fin was undulating and an elastic strapping strip over the rudder hinge was helping out. Curiously enough the movement of the fabric on the fin did not appear to be so uniform as those to the ship, and the next day a series of flights were made over the airport with observers on the ground taking notes while experts in the fin staff watched the fabric from inside.

During the flight part of the trailing strip referred to broke away from the fin and was temporarily repaired in flight. It was decided that until the fin trouble had been further investigated it was undesirable to make full speed trials or to leave the ship at the moorings in the treacherous British winter until it was known how she would behave at full speed. It was then stated that not only would the fin fabric be examined but certain adjustments also could be made to the ring wiring system of the outer cone generally. If this proves really a necessary adjustment after first experience of flying conditions, it is not serious; but if the system itself is under suspicion the matter demands another complexion. In any case it is difficult to avoid the conclusion that the concavity of the sides, the way the girders are sharply curved and the general piling of the cone must entail a higher drag than in the case of R-100.

So far as the handling of the ship is concerned, Maj. G. P. Scott, in charge of flying trials, reported that R-100 handled nicely but in a different way from R-101 and was easy to control. No effect had been made to drive the ship at speed, but the speeds reached corresponded fairly closely with the design figures. With the engines running at 1,400 rpm (500 rpm below maximum), a speed of 57 m.p.h. was reached and there was no vibration, while the ability to use three of the six engines for reverse gave greater control at low speeds.

Turning now to the constructional and design features of R-100 it must be pointed out first that R-200 is primarily of duralumin while the reversed construction of R-101 are of high tensile steel. Although designed to the same specification as to performance, R-100 is totally dissimilar to R-101 and may be said to follow none of the principles of the Zeppelin type. The analogy cannot be pushed very far as in every way, rather practice has been copied. As in R-101 frames and longitudinal, were not needed up to 10 ft. Instead, special known joints known as "splices" were designed for all junction points on an aluminum jig which permitted a large number of joints with varying angles for the setting of the components to be made from the one master jig and the design shape has been adopted in the Zeppelin ships. The same fit shape has been adopted in the Zeppelin ships, and the design shape—5.3 to 1—in, if anything, greater than in R-101.

The power units are six instead of five. These are Rolls Royce Conquer III B petrol engines of 650 hp each, giving a total of 3,900 hp, and these are divided between three cars. Two of these are 360 in from the bow, approximately amidships, and well in front of the passenger accommodation, the third one is 90 ft further aft. The



More: View of the control room in the R-100. Below: view of the Zeppelin during delivery to upper and lower decks.



R-200 scores over R-101 here in regard to weight for in R-101 the power gear total 21 tons while those for R-100 weigh only 16 tons with a total horsepower of 3,900 a top speed of 160 m.p.h. and increased cruising speed of 71.5 m.p.h.

The cars have certain novel features in that the outer portion only is hung to the hull. The front and rear engines being bolted on much as an airplane engine is fixed to the fuselage. It is claimed that this will enable a complete engine to be lowered from the ship while aloft at the same and another hoisted up and bolted into place. A derrick is provided for this job and all the controls, receivers, radiators and oil tanks remain undisturbed in the center portion of the hull.

The propellers are, of course, tractor and pusher. Originally Conquer, Rolls Royce, based on the hydrogen-oxygen engine, and the hydrogen gas turbine, but it became clear that this new type required much more development and also engines were installed at the cost of carrying many tons of gas turbine in the hull. Instead gas turbines are used in each car, and two cars only have ordinary Conquer automobile engines to drive dynamos for electric current.

There is no method of shifting ballast about the ship by power as in R-101 and it is necessary for men to hand pump for 20 min. every hour to fill the gravity service tanks over each engine car whereas in R-101

this is done by power. The estimated performance figures show that with a total displacement of 156 tons a disposable lift of from 55 to 60 tons is available, allowing for atmospheric conditions with a maximum speed of 80 m.p.h. and a cruising speed of 70 m.p.h. When carrying the passenger load of 100 there is available for fuel 26 tons, giving the following ranges under full air conditions: 3,000 mi. at 80 m.p.h., 3,800 mi. at 60 m.p.h., 3,000 mi. at 70 m.p.h.

The passenger accommodation is located in one bay of the ship and is on three floors, whereas that of R-101 is on two bays. The bottom floor is given up to the crew and the two upper ones are reserved for the passengers, the whole passenger coach being surrounded by a double wall through which air is circulated to reduce it from the rest of the ship. There is a central lounge, not as large as that of R-101, surrounded by berths and coming up the height of the two floors, with a gallery round the upper floor. Gangways between the berths give access to the passenger spaces with their glass panels in the ship's sides. These promenade are larger than those of R-101.

The central lounge is also the dining room, and the adjoining electric kitchen rather suggests that the smell of the food may be with the passengers even when meals are not being served. There is no smoking room, either, and it seems that the passengers are more or less bound in one room all the time. On R-101 there is the operation room, the separate dining room that sits off from the rest of the ship and the small but much desired smoking room. R-101 has two berths below only, whereas R-100 has four berths below, and these upper ones are cramped than those of the other ship.

A serious difference which appears to be in favor of R-101 is that an evaporative cooling system makes the equivalent heat of 1,000 hp in one radiator available to warm the air circulated by a fan into the passenger quarters. R-100 depends upon electric radiators and this, even, of course, that the auxiliary power unit, being a heavy load and probably that the air in the quarters will not circulate so rapidly.

Another important variation is the form of construction of the main frames, which still retain the usual



The R-101 under construction at the Zeppelin Works, Germany, about at London in 1910.

bracing associated with Zeppelin construction. The leads in this, it is claimed, are taken by a central girder running the whole length of the ship along the axis but it still seems that with displacement of gas bags across leads may come on the frames in a way which has been observed in R-101 by the use of deep girders from which are rigid without any radial bracing. On the other hand, R-100 has evidently gained in total gas content by this system for the total displacement is given at 156 tons as against 150 tons for R-101. The axial girder on the other hand, complicates the making of the gas bags, which have a central hole to permit the girder to pass through. However, this may render easier the actual construction of the gas bag as it can be hoisted up on the girder which is then connected up on each side to the center point of the radial wires.

Triangular girders are used everywhere for main frames and longitudinal, but these, like R-101, use tubular beams with stepped lattice work connecting struts. The beams are rather aggressive as they are made from duralumin strip rolled up in a spiral to form a tube and then riveted along the seams. The whole operation is carried out in a special machine quite expensively, and this system has the advantage of permitting tubes of 5 in. diameter to be formed with control of the quality and strength of the metal used.

The three beams then are mounted in a jig and the lattice struts riveted into place, while each girder is fixed off with a standard screw and made of solid

while construction has been most ingeniously thought out to reduce the dissimilar parts in the ships to 42. There are not more than three dissimilar parts in the whole of the longitudinal girders and only thirteen different parts in the construction of the transverse frames. Yet each girder is curved to give a proper continuous aerodynamic shape and the design, it is stated, is such that all loads in girders are either pure compression or tension. Throughout the ship, too, a system of guiding the girders and shear webs has been followed, the strength and, therefore, the weight of each girder varying with the local stress in that particular area.

NATURALLY in the low where the mooring strains are concentrated the girders are one piece and riveted in to the center by the principal struts are due to lagging loads (that is, the ship trying to bump its back). Here the longitudinal girders are stronger to resist compression than the topmost girder which has to carry a side load in tension. The same principle applied throughout the ship has enabled external stresses to weight to be made without, it is claimed, any loss of strength. The fins and tail planes are fixed to the hull in a new method by means of girders shaped like a cross, the center of which is a cross strengthened axial girder, the whole being tied again to the spider webs.

These spider webs, in fact, are the vital members of the ship and upon these as hang, as it were, all the loads. The lift of the gas bags is taken in these, and the passenger accommodation again is taken to the spiders so that all loaded strains in girders or frames are avoided. The control air and the engine nacelles as in R-100, are the only projections from the ship, and a very low drag is expected.

There is another size difference between the two ships as to weight setting as it may be important from the viewpoint of production cost in future ships, and this is in the design of the rags. It is claimed for R-100 that as the rag or a self-braced unit, it is possible to build it in on the floor of the shed, mount all tanks, pipes and auxiliary apparatus in the ring economically at that point, and thus merely bolt the ring up horizontally and it is high enough to allow it to swing vertically into position whereas with the radially braced frame of R-100 this is not possible and most of the work must be completed after the ring is in position high up in the shed.

R-101 is undergoing modifications which the flight tests have shown are possible to increase the performance, the chief of these being an increase of gas bag capacity by reducing the clearance between the setting and the frame of the ship. This will add about two tons to the lift, and with other alterations, it is commonly held that R-101, despite criticisms, based against her carrying capacity, may in the end have a surprisingly good performance. It must not be forgotten that whereas with gasoline engines, as in R-100, there is a definite drop in economy with the lower throttle openings, R-101 ships with her compression ignition engines as the fuel consumption is proportional to the throttle opening. The slower running engines of R-101 may help to produce efficiency at the lower speeds, and it is almost certain that a higher percentage of power is converted into useful thrust in R-101 than in the case of R-100. Thus there may yet be surprises to come when the R-101 comes out again in March, especially if a successful metal blade can be evolved to enable all engines to be used for forward movement, instead of one being reserved as now for auxiliary purposes.



Checking how their spider webs are fixed from the ship to the outer gondola.

duralumin. These connect at the junction with each ring with the special framework called a "spider." Because it takes up every girder both in frame and longitudinal. It has a corresponding screw slot to tie up with the longitudinal and axial construction to be made by a right and left hand twisted duralumin collar so that the longitudinal axis together with the two ends of a sandwich. Naturally the particular angle of the twisted screw slot varies with each frame and this allowance is provided for in the setting up of the spider in the jig. Another feature of the spider is that all bracing wires pass through the central axis, and are held there by being passed through a steel tube which grips the wires at its ends.

Standard and fittings are used throughout, and it's



HIGH POINTS in the NEWS

► **Parley to Carter.** Skotted, bearded, and floating-colored Tanager granted \$100,000 grand prize to Guggenheim-Sole Aircraft Competition, as Header Page entry bids to pass international gliding speed requirement.

► **But Header Page-Carter** court action goes further, as later court action did permit infringement suit brought by former by ruling on non-personal aviation first speed in non-personal class, to hold Header Page prize.

► **Misses ready.** After All American Air Meet scheduled at Florida city, Jan. 13-15.

► **And.** Eight day test of Florida airports by team two were places follows Miami team. Displays and races planned at St. Petersburg, Tampa, and Orlando next.

► **Prize report 29 trophies.** Before last month's race, Buffalo City's plane took 230 points, 641 engines. American Eagle took 210, 55 points. Wickham led 16,000 150 points.

► **Learning seriously fast.** Federal Bureau reported in 32 states, 20 ask data for all twelve ask them for statistical plans and flyers only for states require other state or federal licenses, as others ask state licenses only, right states ask none at all.

► **Shively jump.** Budget of Governor Roosevelt, New York, city for \$10,000 acquisition for state plane. Buffalo will mean some aircraft purchase later.

Airports and Airlines

► **Are you a Tanager?** To be eligible for New Arrow first scheduled at Haverhill, Mass., you must be an airport and school members will be trained.

► **Cover State in New** toward state on his last year \$405 per mile. Detroit-Chicago \$18. Detroit-Chicago \$18.

► **Are action ready.** New York, Rio & Buenos Aires line to open Buenos Aires-Rio division at Jan. 15.

Europe

► **Are stationary.** Polity Amsterdam Works, shows putting in each year. Polders, now used by 150,000 in 30 countries, they are built by rubber factories in former colonies.

GENERAL NEWS

HERBERT F. POWERS, News Editor



HIGH POINTS Tanager Wins Grand Prize in the NEWS In Safe Airplane Contest

MITCHIE FIELD (L.A. wire)—The highest authority revealed and the strongest expression of professional approval given, granted to the Curtiss Aeroplane & Motor Corp. entry the "Tanager" in the Guggenheim Safe Aircraft Competition, with the formal award of the \$100,000 grand prize.

Award of the prize was made here Monday, Jan. 6, in the presence of members of the Guggenheim board and its two experts, headed by Capt. T. S. Land, vice-president of the fund and its active head, in the absence of Harry F. Guggenheim, administrator in Cuba.

But March of the 22 miles upward reservations for the contest against Mitchell Field tests, and the British entry, the Humber Page, found that Tanager's only serious rival. The English entry proved practically all of the qualifying time but failed to obtain the minimum gliding speed of 35 m.p.h., as called for by the rules. The best time that crew could do was 30.7 m.p.h. The judges also stated that in the narrow conditions of trial and rig the Humber Page performance was open to considerable doubt as to most comparisons with the requirements of "general stability" and "safety" from violent disturbances.

A Prize to Britain

As the Tanager was the only entry to pass the qualifying requirements, it was not necessary to hold the final competitive trials which were originally planned to determine the winner on a point basis, under identical weather and field conditions.

The presence of aghast glaucous test by the air authority requirements, the larger-powered Tanager, is generally reported as a high tribute to Curtiss engineers and in particular to Robert R.

Chobert, the one most responsible for the design.

Wing tips were placed on the Tanager along high tops and lower wings, and the leading edges of both wings were covered with flap. These flaps were controlled by a crank operated from the pilot's cockpit. Apparently working were the ailerons, of full leading type which were placed at the tips of the lower wings. The plane has a span of 44 ft. and a maximum chord of 6 ft.

It is reported that the Curtiss concern already producing construction such with Tanager features.

Others Scored

Judges for the competition were Orville Wright, chairman; F. Truett Davidson, Assistant Secretary of War for Aeronautics; William P. MacCormack, Jr., head, Assistant Secretary of Commerce for Aeronautics; Edward P. Warner, editor of *Airways*; and former Assistant Secretary of the Navy for Aeronautics, Dr. George W. Lewis, director of the National Advisory Committee for Aeronautics; and also Alvin Richard E. Clark, Jr., the industrial engineers were Prof. Alexander Klemin, of New York University, Capt. E. E. Ames, of the Aviation Division of the Standard Oil Co. of New Jersey, and also R. H. Myers, representative of the Guggenheim administration based in England.

The tests in the competition were started at Mitchell Field in June, 1935, and were conducted by the Pacific points, Thomas Corry, formerly N. A. C. A. C. pilot, Edward W. Koenig, Navy test pilot, and Lewis Stanley, United States Navy test pilot at Mitchell Field. The Pacific Manager of the competition was Capt. William Beader Army Air Corps.

(Continued on page 10)



Robert R. Chobert, showing use of the Tanager's leading ailerons.



SIDE SLIPS

AVIATION
January 13, 1939
By
Robert R. Osborn

THE MONEY MARKET jumped on us so suddenly this year that we almost forgot to make our annual recollections. The family resolves to get our "Side Slip" essay in to the Editor on time during 1939.

[Editor's Note: We've proved this resolution every year now, but don't let it fool you—the copy will probably be later than ever.]

[Author's Note: Is it so? We had it in no less time in 1938.]

[Editor's Note: It was in on time twice, once when there was a holiday and we published a day late, and once when the copy was so late one week, it was on time for the next.]

[Author's Note: Shucks!]

SOMEONE sends us the following clipping from the New York Herald-Tribune "Caterpillar," Dec. 30, 1938: Mrs. Roberts Latimer Pelton, former United States Senator from Georgia, has enjoyed a new thrill—her first trip on the clouds. Mrs. Pelton recently was a passenger aboard the Vigilante winged-glider of the Goodhue Corporation, and on alighting after her first ride in an aircraft declared she was thrilled.

There is no thrill, though, is quite as big a ride in a winged glider.

We are that one of the air lines has refused an offer to equal that of the Pullman line in an attempt to interest traveling salesmen in the service. Judging by the traveling salesman stories we have been hearing for some time it will be a good thing for the results of the country to get them out of the big cities to quickly in possible and keep the traveling salesman out of the traveling districts.

THIS WEEK'S AVIATION: AERONAUTICAL EXHIBIT

The following items were presented at the Evening Tribune of San Diego, Cal., "Alameda Airfield Exhibit, trans-Alameda flight, arrived at the Alameda Airport at the controls of a Trans-Alameda T.A.T. Midgets air line, serving cities others from Los Angeles."

Since our comments a few weeks ago on the news that a new had been the ruler off of Mr. Richard Hart's ship when it was parked in a pasture overnight, we have had a number of letters which show that ones are quite fond of Grade A cotton when treated with the right dips, in fact, they seem to be so fond of it that they seem to be in a good solution for the problem of our ocean airplane studies—they might be run through the cotton and blown into the air. Our interesting letter as ever" also comes from J. L. Echols, of San Antonio, Texas:

"This incident to Mr. Hart's ship provides a laugh but it is correct for us familiar with 'new country'! Down here in Texas you can find a barnhouse man who is not aware of the owner's appetite for dips. In 1920 I had a three-day cruise on the road and I became fully familiar with the subject at El Campo, Texas. My 'prince-prince' night, without doubt, was off to sleep and I arrived at the field to find the tail groups and wing tips of all these ships completely gone. Either, fortunately, or unfortunately, the right wing of my personal ship had undergone some patching the day before and the first dip set up a severe case of indigestion in two of the airmen, from which one died a few days after we had finished our expedition there. I was promptly sent to the farmer for having set up such

an instance or incident from the last time. The fact didn't get anywhere, however, because the lawyer was heard that all those dollar notes were being taken up and so he all right—as I am told that he related to his client that 'those flying cotton fellows had no money—therefore his client asked 'What did they go broke?' The answer was that they never 'went' broke, they just 'stayed' broke.

On a trip to the Argentine, from which I have recently returned I learned that a new is just a new airplane in the world. Flying for a British mechanic,—on upon the right on one of his ranches near Tomy—200 miles northwest of Bahia Blanca on the P.P. Ry, and about 100 miles south-west from Buenos Aires. During the night several steps down the level broke down the level broke down I had both around the crane and stabilized in wing tips, rubber and rubber. One thing is good and plentiful there,—right on the edge of the Pampas,—but nevertheless, they will make good ground for dips anywhere in the world.

You may remember that one of the airplane manufacturing companies actually made some money a year or so ago—by building their capital stock into money to the stock market as an end money, at the first rate of interest which was prevailing at that time. Now, Mr. R. B. of Kansas, Wash. sends a clipping from a financial period about under astronomical rate which is making money.

"San Francisco (Enquirer) Dec. 12: Kansas City, Kansas, 12/11. The first cash dividend ever paid on common stock of an airport is the U. S. was declared by directors of Fairfax Airport, Inc. of Kansas City today when they authorized the payment of 25¢ on each share. Dividend represents profits from the sale of several gas from Kansas wells on the field."

GET THESE NOW

Here are reasonable items—universally needed—at prices you can't resist. Now is the time to avail yourself of these splendid bargains!



Johnson
Wind Cones

Here are quality wind indicators. Not made from cheap materials which rapidly fade in weather; we spray the goods on the cone with a mixture of chrome yellow that preserves the materials and makes the color last. Style 2 shown above, Department Commerce Standard, is really lighted. Heavy and durable in construction, supported from a tower or mounted on 1/2-in. pipe standard, self-contained with cone, light and wiring, retaining fixture, complete \$15.95. Cost only \$9.00

Cone Style No. 3, Department of Commerce Standard fog signal of A-1-A ratings—16 in. x 12 in., cost only \$12.00. Same cone with fringes... \$20.00

Johnson Flying Suits

The Commercial Air No. 34 Suit is an exceptionally fine winter suit at a moderate price. Olive drab, water proofed, sheepskin cloth lined throughout with wool absorbent; wide flat collar, zipper fasteners, large pockets, sizes 36 to 46; price only \$60.00. Johnson's Special Winter Flying Suit No. 37 is similar to No. 34 except for a beautiful wool blanket lining. Not quite as heavy, but exceptionally warm and comfortable—well priced at a genuine bargain at only \$35.00



FITTINGS—1, Wheel of Gears; 2, Union Nipple; 3, Street Ell; 4, Hose Nipple; 5, Part Line Structure; 6, Plain Cone; 7, Pipe Nipple; 8, Hose Lanyard; 9, Rotating Flange; 10, Union Tee

Johnson Tail Wheel

Built to stand the pull but simple in design and easy to assemble. These big advantages (1) Lightest weight on market; (2) Lowest prices; (3) Only tail wheel Tiresmen equipped to tire on end or side-load. Two popular sizes, 14 x 3/4 in. (which also takes 1 1/2 x 4 in. tire), and 10 x 5 in. (which also takes 12 x 4 in. tire).



Think of Johnson First...

as a dependable source of supply for everything aeronautical. Dependable in quality, price and service. Strict accordance to government standards. Being both manufacturers and distributors, we can supply your needs in practically every line. Write today for your copy of our big free catalog or send us a trial order—see what Johnson service means!

JOHNSON
AIRPLANE SUPPLY CO.
DAYTON, OHIO

531 West Douglas Avenue
Woburn, Mass.

224 East Seventh Street
Los Angeles, Cal.

MAIL THIS!

Johnson Airplane & Supply Co.
Dayton, Ohio

Ship me the following items as described in this ad—under no circumstances to be returned.

Remittance enclosed for \$
Also send me your big, free catalog.

Name
Address



Translating a Vision into Brick and Steel

THE new house of The Glenn L. Martin Company which is rising on the outskirts of Baltimore is the crystallization of a dream—a dream of a place where a group of aeronautical engineers and artists will be able to live, labor and plan in surroundings conducive to the greatest mental stimulation and the most effective performance.

THE GLENN L. MARTIN CO.
Division of Quality Aircraft since 1912
BALTIMORE, MARYLAND



The Aircraft Engine ... its care and lubrication

The December issue of The Texas Company's monthly magazine "Lubrication," is devoted wholly to the subject of efficient aircraft engine lubrication. It contains a most interesting and complete discussion of this vital subject.

This issue, while the edition lists, will be sent free to all who write for it.

The Texas Company stands out in the field. Its own planes are constantly touring

the country. Texaco Aviation Gasoline, Texaco Airplane Oils and Texaco Marmak Greases are available at the important landing fields in every State. The Texas Company was the first to provide aerial service stations. The Texaco Red Star with the Green T stands for progress and safety in the air. Write The Texas Company. Use the coupon for your copy of the December "Lubrication."

TEXACO AVIATION GASOLINE
TEXACO AIRPLANE OILS
TEXACO MARFAK GREASES

THE TEXAS COMPANY
17 Battery Place New York City



THE TEXAS COMPANY, 17 Battery Place, New York City
Please send me a free copy of the December issue of "Lubrication."
Name _____
Address _____
City _____
State _____

A few GROUND LOOPS avoided might pay for surfacing your runways



YOU CAN BUILD FIRM, RESILIENT, MUDLESS, DUSTLESS RUNWAYS ECONOMICALLY WITH TARMAC

Pilot's flock to airports where Tarmac-surfaced runways provide year-round all-weather take-offs and landings.

Tarmac runways make landings safer.

They make take-offs faster and more certain.

They enable you to keep your airport operating all year round and avoid the seasonal tie-ups.

They inspire public confidence in the safety of air travel.

Moreover, they can be built without great outlays of money. Tarmac (a scientifically-prepared coat for which is carrying heavy traffic on such highways as the Lincoln, William Penn and National Highways) can be used with locally-available materials to build your runways, landing strips, taxi strips, hangar aprons, etc., at relatively low cost.

Let us send you information about the use of Tarmac for your airport paving.

AMERICAN TAR PRODUCTS COMPANY

Division of The Koppers Company

General Office: PITTSBURGH, Pa.

Four District Offices: The Products Corporation, Cincinnati, O., B.

Plans:

Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio

St. Louis, Mo.
St. Paul, Minn.
St. Petersburg, Fla.

San Francisco, Calif.
Seattle, Wash.
Portland, Ore.

Los Angeles, Calif.
San Diego, Calif.
Phoenix, Ariz.

Ground of a Tarmac surface, showing its granular, dust-proof composition.



Tarmac

FOR GOOD
AIRPORT PAVING

E M S C O

A COMPLETE LINE OF AIRCRAFT FOR LAND AND SEA



The Emsco Courier—low floor, covered wings, and wing doors. This aircraft will carry 10 passengers, 100 lbs. each, and 100 lbs. of baggage.



The Emsco Scout—high wing, high floor, and high doors. This aircraft will carry 10 passengers, 100 lbs. each, and 100 lbs. of baggage.



The Emsco Defender—high wing, high floor, and high doors. This aircraft will carry 10 passengers, 100 lbs. each, and 100 lbs. of baggage.

EACH A LEADER IN ITS CLASS

Engineered on sound principles that have been proven by years of experience in commercial and military aviation. Built by master craftsmen on a new \$1,000,000 factory equipped with the most advanced production methods. These three types of Emsco Aircraft are primary events due their superiority in providing safe and transportation with greatest economy.

The Emsco Courier has flown cross-country under normal flying conditions with a fuel consumption of only 0.8 gallons per hour at cruising speed. Twice the 1.5, powered with a 200-hp. Wright Whirlwind engine of a gross load of 1,000 lbs. with a top of a full mile. The Emsco Scout has demonstrated its dependability, safety and economy in flying more than 10,000 miles under all conditions, without the last four months.

In addition to these, the Emsco Aircraft Corporation has under construction at this time four new and distinctive types of planes, which, when completed and added to the present group will make the Emsco line one of the finest and most complete in the history today. These four include:

(1) A four-engine plane carrying 100 passengers, two pilots and two crewmen, four 700-hp. engines—built, designed for all-weather conditions and absolutely flying, also offering economical transportation.

(2) The Emsco Defender—4 to 1000-lb. payload, 1000-hp. engine, built for heavy duty transportation.

(3) The Emsco Scout—4 to 1000-lb. payload, 1000-hp. engine, built for heavy duty transportation.

(4) A special long range monoplane—extremely streamlined, designed for record distance flight.

All Emsco land planes are delivered from the factory with positive floats in that no structural changes are necessary to quickly change them to seaplane configuration. The first step only is to install a 1000-lb. float for seaplane operation. Alternatively the planes are designed for amphibious operation, performance data and plans will be furnished on request.

EMSCO AIRCRAFT CORPORATION • DOWNEY • LOS ANGELES COUNTY • CALIF.

This is one of a series of advertisements devoted regularly to advertising men in an effort to make industrial advertising more profitable to buyer and seller. It is printed in these pages to our subscribers to remind that McGraw-Hill publishes standards news advertising opportunities as well as editorial writing.

Is your copy keeping step with your salesmen?

AN eastern manufacturer selling a product for general industrial use has advertised consistently in six McGraw-Hill publications. His sales year after year have been so satisfactory that he has readily renewed his advertising contracts.

The product is staple—one of those prosaic things that make copy writers age prematurely. A new competitive situation came up last fall that made

the copy obsolete. The advertising writer left his copy desk and turned salesman for a while. He returned with a sharpened pencil and a new viewpoint.

The new copy has been running now for several months. No change in advertising schedule! No change in sales policy! No change in product design or service! Nothing has been changed except the copy, which has become more sales-like and more humanly interesting.

NOW comes the president's report on sales for the first quarter. Does it not show that it pays to scrutinize copy as well as the mediums that give it voice?

THE REPORT*

I am inclined to believe that the new type of advertising is getting the results we had hoped for. In fact it is coming much better than we had reason to expect. We are very busy in the plant at the present time and our sales for the first quarter are running 25% higher than former years, which is quite a jump. The particular class of work we treat that in this advertising has proved that one practically doubling the machinery in this department and it is now operating on a 24-hour schedule.

*Extract from a personal letter among several subjects

McGraw-Hill PUBLICATIONS

New York Chicago Cleveland Detroit Philadelphia St. Louis
Greenwich San Francisco Boston London



When You Teach Him to Fly— Sit Side-by-Side in an INLAND SPORT MONOPLANE

No engine is better for teaching than the high-wing, two-seater Inland Sport Monoplane. Its side-by-side seating arrangement enables instructor and student to talk face-to-face in ordinary tones, even while flying at high speeds.

The instructor can point directly to the controls which the student operates . . . can teach them at once. There's no need for hush-hush hand signals . . . no necessity for pretenses and a complicated code of signals to "keep him from doing" and so on. The instructor simply tells the student what to do . . . and he does it.

If the student wishes a mistake, the instructor can correct him instantly. This eliminates waste of time . . . saves engine hours while instructor and student "talk it over" . . . gives the operator an on-the-spot check during each correction . . . and best of all, reduces to a minimum the possibility of accident. Several side-by-side in the same cockpit with the student, the instructor can correct serious blunders before disastrous results occur.

Sturdily built, the Inland has the strength and ruggedness to withstand the harshest weather conditions. It will take the bumps like a gentleman . . . absorbs shocks without serious injury to its control system.

Above all, the Inland is economical to own . . . economical to operate. It makes schools so profitable to own or lease and is just one per cent more than necessary . . . of this, to easily meet students in the same length of time with your present staff of instructors.

Powered with a Jifford 40 or Warner-Smith engine, the Inland is a quick, low-price sport plane with low requirements of design, beauty of line and color, performance and reliability. May we send you further details?



This actual photograph shows how easily student and instructor may communicate in the Inland Sport.



Manufactured at Fairfax Field, Kansas City, Kansas, by Inland Aircraft Co., Inc.

USING a stock model Inland Sport, Lt. WELSH D. Moore recently set a new American light-plane record for altitude . . . and later, in the same Inland, set a new world's speed record for light planes over a closed course.

INLAND AVIATION CO.
Fairfax Field, Kansas City, Kansas




 SPONSORED BY AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

INTERNATIONAL AIRCRAFT EXPOSITION

1936 is the "Year of Merchandising" in Aviation. Today the industry meets a new stage. Questions of performance, of manufacture, and of finance, have already been met and answered. Now we must turn to Sell! On this problem the known minds are centered. An solution will be reached at this great Show. Here, the meeting of all the physical achievements of the industry, a vast Pageant of Transportation, the gathering of thousands of interested progress, and Merchandising Conference of far-reaching importance make this Major International Exposition of the year an event of utmost importance. The world's Aviation leaders and an army of prospective dealers will be there. Will your product be represented? Then it will come to your attention by communicating immediately with—*Cliff W. Meadows, Manager, Aircraft Show Service*

AERONAUTICAL CHAMBER OF
 COMMERCE OF AMERICA,
 INCORPORATED
 212 South 10th St., Suite 242
 St. Louis, Missouri

**FEB.
15-23
1936**

WORLD
 AIR FAIR

ST. LOUIS ARENA

In Byrd's polar plane



FEW aircraft engines have ever been called upon to face the hazards encountered during Admiral Byrd's South Pole flight.

Intense cold, unusually lofty flying altitudes, high speeds, a very heavy load—these were some of the conditions met and overcome by the Wright engine of the tri-motored "Floyd Bennett" during the remarkable 19-hour flight above the frozen wastes of Antarctica.

Like the engines that have driven so many other planes on memorable flights, these engines had vital parts made from Bethlehem "Airplane Quality" Steel Forgings, including the right connecting rods and rocker arms of the Wright

Cyclone Engine, and the right connecting rods, master connecting rod and rocker arm of the two Wright Whirlwinds.

In ordinary cross-country flying, just as in climbing over the wind-swept Polar Plateau, airplane engines require steels that are as strong and enduring as it is humanly possible to make. You can place full dependence on Bethlehem "Airplane Quality" Steels and Forgings. They meet every test.

BETHLEHEM STEEL COMPANY
General Offices: Bethlehem, Pa.

Representatives: New York: Roden, Philadelphia: Johnson, Washington: Adams, Cincinnati: Smith, Cleveland: Smith, Chicago: Johnson, St. Louis: Smith, San Francisco: Smith, Seattle: Portland: Smith

BETHLEHEM

"AIRPLANE QUALITY"

STEELS • FORGINGS



Cessna Hawk P-34
U. S. Army Plane
equipped with
HASKELITE
plywood in wing
and other parts

PLYWOOD
HASKELITE
PLYMETL

SPEED >>

—through the terrific stresses induced, makes a plane its own testing laboratory.

In the fastest planes you'll find HASKELITE, the blood-albumin-glued aircraft plywood. Data sent on request.

Haskelite Manufacturing Corporation
120 South LaSalle Street, Chicago, Illinois

Raymond & Jones Engineering Corp., Ltd.
National Aeronautics Association, New Orleans

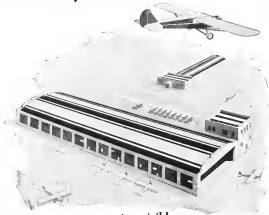
Raymond & Jones,
Purdue Field,
Box 105, Garden City, N.Y.

California Pacific & Western Co.
310 S. Main Street, Los Angeles, Calif.

United States & Southern Co.
311 West 10, Fort Worth, Texas.

2-11-38

AS SEEN from the COCKPIT...



—super-visible,
super-durable,
this Carey "aeronautic" Roof!

This drawing shows how it looks from the air, the Carey Roof designed especially for service in the aviation field. Meeting every existing requirement of arched roof construction—offered in cooperating colors to give added visibility. Elastic, tensile-tough, extra-strong. Glass laminated, built up, layer upon layer. The Carey "aeronautic" Roof—the roof which repays its original cost, many times over, in extra years of service.

May we tell you more about Carey Roofing Specifications for the Aviation Building? Write.

THE PHILIP CAREY COMPANY
Leckland, CINCINNATI, OHIO

FOR AVIATION FIELD SERVICE:

Carey Elastic Expansion Joints for runways
Carey Corrugated Asphalt Roofing and Siding
for Fireproof Buildings
Carey Aeronautic Heat Insulation Materials

PHILIP

Carey
PRODUCTS

Safe!



Where there is no landing there must be no failure.

For SPRINGS of any kind, of any material, for any purpose in motor, controls or landing gear, use

GIBSON SPRINGS

WM. D. GIBSON CO.
1800 Clybourn Avenue
CHICAGO, ILL.

SEND FOR OUR CATALOGUE



Saves skilled hands for repair work

CLEANING is costly when highly paid mechanics must spend valuable time scrubbing and scraping.

Get away from this wasteful practice . . . leave your men free to do more actual repair work . . . by using Oakite materials and methods. The powerful cleaning action of Oakite materials, used in spray equipment or tank, quickly loosens grime, grease, and burnt oil from exhaust cells from motor parts, wings and fuselages. Then a brief rinse leaves surfaces spotless and film-free, ready for inspection or reassembly. Time is saved . . . scrubbing reduced to a minimum.

Find out how Oakite materials can be profitably employed in your maintenance work; how they will help you get your planes back into the air more quickly. Our nearest Service Man will be glad to explain. Just drop us a line.

Manufactured only by
OAKITE PRODUCTS, INC., ONE THOUSAND N. NEW YORK N. Y.
Oakite Service Men cleaning facilities are located at
Atlantic City, N. J.; Baltimore, Md.; Boston, Mass.; Buffalo, N. Y.;
Cleveland, Ohio; Cincinnati, Ohio; Dallas, Texas; Denver, Colo.;
Detroit, Mich.; El Paso, Texas; Fort Worth, Texas; Gary, Ind.;
Hartford, Conn.; Indianapolis, Ind.; Kansas City, Mo.; Los Angeles, Cal.;
Miami, Fla.; Milwaukee, Wis.; Minneapolis, Minn.; New Orleans, La.;
New York, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Ore.;
Rochester, N. Y.; St. Louis, Mo.; St. Paul, Minn.; Seattle, Wash.;
Spartanburg, S. C.; Toledo, Ohio; Tulsa, Okla.; Wichita, Kan.;
Yonkers, N. Y.; and many other cities. For a complete list of
locations, write to Oakite Products, Inc., One Thousand N. New York, N. Y.

*Samples of Oakite materials are sent to those who.

OAKITE

Industrial Cleaning Materials and Methods



Testament Testimony Landing with B.B.T. Air Mail Type M-40 Floodlight

You need never be in doubt.. B.B.T. Floodlights

now available on a

Free TRIAL BASIS

will, if given the opportunity, conclusively prove their right to your preference.

At your own Airport—with the aid of your own pilots—under your own supervision—you can now conduct whatever tests you choose.

Flight Test these Floodlights under varying weather conditions. Try them on dark-early-morning nights, when adequate illumination means so much to the Pilot. Test them for intensity, even distribution, area coverage, complete beam control (no stray spread light to blind the pilot) then learn of their



Typical installation of B.B.T. Air Mail Type M-40 Floodlight

**Low first Cost
Low Installation Cost**

**Economy of operation
Ease of control**

We feel certain on the basis of such superior performance

"AVIATION'S bad weather FLOODLIGHTS"
will be chosen for your airport.

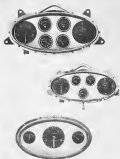
Write for full details of this Free Trial Plan under which you incur no obligation whatsoever.



MAKE YOUR AIRPORT SAFE FOR NIGHT AIR TRAFFIC—FLOODLIGHT WITH B.B.T.

UNIT CONTROL

One glance at your ELGIN Unit Control Board and you know exactly how your power plant is functioning. No squinting into dark corners. No acrobatic twisting to learn what your engine is doing. It's handsome, reliable, accurate . . . and not expensive. Why not date your instrument board 1938?



AIRCRAFT INSTRUMENT DIVISION
ELGIN NATIONAL
WATCH COMPANY

ELGIN  ILLINOIS



The Nation's Aces Keep Warm And Comfortable In The Coldest Flying Weather!

Watch those pilots who do record flying when the air snaps with frost and frigid temperatures beat back all but the properly clothed. All of these pilots are dressed in warmth and comfort. Most of them are dressed in Snugg Flying Clothes.

Arthur C. Guebel

One of the pilots of national renown who enjoys warmth and comfort in SNUG FLYING CLOTHES.



Curvies Leather Specialty Co.
Trenton, New Jersey



Amber Bakelite Resinoid is superior for gasoline sight gauges

THE extraordinary service of the airplane places new demands upon equipment. Even the smaller parts, such as gasoline sight gauges, must possess more than the primary requisites of light weight and strength. Bakelite Resinoid is durable—with less weight and greater strength than glass—and also provides a superior sight gauge.

Unlike glass, Bakelite Resinoid may be threaded, eliminating the need for metal attachments. A hard blow may break or crack Bakelite Resinoid, but will not shatter it.

In service, the amber Bakelite Resinoid gauge has distinctive qualities. The pleasing amber color eliminates glare and eye strain. The sight gauge of Bakelite Resinoid is unaffected by weather conditions and does not collect moisture deposit in temperature changes. Bakelite Resinoid affords pilot protection in that it is non-inflammable, will not explode and does not shatter.

Manufactured by Bakelite Corporation, New York, N. Y.

Write for literature: BAKELITE Corporation

BAKELITE CORPORATION
247 Park Avenue New York, N. Y.
Chicago Office: 615 W. 12th Street
Bakelite Corp. of Canada, Limited
161 Dufferin Street Toronto, Ontario

BAKELITE

THE MATERIAL OF A THOUSAND USES
REGISTERED TRADE MARK



If it's DEPENDABILITY you want...

...to keep your Production Lines on the move, Barnes-made Springs have been building a reputation for dependable service for years. Won't you tell us your spring requirements—one or a million?

★

The Wallace Barnes Co.
BRISTOL, CONN., U.S.A.

2nd ANNUAL
INTERNATIONAL
NEW YORK AVIATION SHOW
Association of
AVIATORS' POST 35
America Legion
Address of correspondence to:
NEW YORK AVIATION SHOW
110 West 42nd Street
New York City


ENTERTAINMENT
ACTION—THRILLS
In the Heart of the
World's Greatest
Amusement District

**GRAND
CENTRAL
PALACE**

FEB. 7th-15th



HIGH GRADE
Gears—Cams—Precision Parts



INDIANAPOLIS TOOL & MFG. CO.
INDIANAPOLIS, INDIANA

S.S. White
Flexible Shafts
for
Tachometer Driving
and other
Power Transmission
{ Made by the largest producer
of steel wire flexible shafts }

The S.S. White Dental Mfg. Co.
Industrial Division
138 West 42nd St. New York, N.Y.



Also for fuel lines,
heat, gas, no. request

GOVRO-NELSON CO.

The Warner

"SCARAB"



Specialists in the
Manufacturing of Crank Cases, Cylinder
Barrels, Cylinder Heads, Pistons, Oil
Pumps, and Small Allied Parts

1951 Antennette

Detroit, Mich.

Winter Weight Helmets

NAVY No. 1—Corduroy fabric. 1 lb. 10 oz. \$10.00
NAVY No. 2—Corduroy fabric. 1 lb. 10 oz. \$10.00
NAVY No. 3—Corduroy fabric. 1 lb. 10 oz. \$10.00
NAVY No. 4—Corduroy fabric. 1 lb. 10 oz. \$10.00
NAVY No. 5—Corduroy fabric. 1 lb. 10 oz. \$10.00

Nicholas-Beazley
Airplane Company Inc.
Manufacturers of MILITARY
WESTERN BRANCH—5000 Market Ave., Los Angeles, Calif.

PITCAIRN AIRCRAFT



For Air Mail use . . . SUPER MAILING
For Sport or Private use . . . SPORT MAILING

PITCAIRN AIRCRAFT, INC.

**SEAMLESS
STEEL TUBING**
All Aircraft Grade

Manufactured to exacting
standards in any quantity—
Minimum quantity for industrial
production requirements.

SERVICE STEEL COMPANY
1110 Broadway
New York 10, N.Y.

PACEMAKERS

More A. R. Bell, Vice-President
of the Pacific
Aircraft Company, is shown
in the center of the picture.
He is shown in the center of the picture.
He is shown in the center of the picture.

REBLINER-JOYCE
AIRCRAFT CORPORATION
BALTIMORE MARYLAND

**PERFECT
FLYING
VISION**



LUXOR
GOGGLES by *W. H. Grogan*

Send for catalog 520 Fifth Ave. New York

23
Makes of Planes Now Standard
Equipped With

AEROL LANDING STRUTS

Every landing gear of Aviation (as well as every
other) of these landing struts! covers full page
illustrations including individual photos in the
group. Write for information.

THE CLEVELAND PNEUMATIC TOOL CO.
Cleveland, Ohio

**SEAPLANE
FLOATS**



**FLYING
BOAT HULLS**

SEYMOUR J. BAUM, Inc.
289-291 Albee Street
Brooklyn, L. I.

Aircraft Service Directory

See our Advertisement
in each issue for
the month's new
PIONEER INSTRUMENT COMPANY
124 E. 42nd Street, New York 17, N.Y.

HASKELLITE

Best for your aircraft today. Haskellite is the most popular aircraft material in the world. It is the only material that is both fireproof and waterproof. It is the only material that is both fireproof and waterproof. It is the only material that is both fireproof and waterproof.

Prices Paid for Aircrafts
Based on National Aircraft Price List for the following series of aircrafts are shown in the following table. Prices are shown in the following table. Prices are shown in the following table.

TRIUMPH

PIPER, HARRIS, P. 12, AIRCRAFT
Piper, Harris, P. 12, Aircraft. Piper, Harris, P. 12, Aircraft. Piper, Harris, P. 12, Aircraft.

Patent Your Ideas
Send me a sketch or a description of your idea. I will tell you if it is new and if it is patentable. I will tell you if it is new and if it is patentable.

DANIEL GUGGENHEIM SCHOOL OF AERONAUTICS
School of Aeronautics, 1234 5th Avenue, New York 17, N.Y. School of Aeronautics, 1234 5th Avenue, New York 17, N.Y.

Northeast
HENNETT-GOGGERS
FLYING CLUB
1234 5th Avenue, New York 17, N.Y.

MOTORIZED YOUR HANGAR DOORS
Allen & Deere, Inc.,
Cincinnati, Ohio

PITCH & BANK INDICATOR
New Product as a glass
with a compass. Pitch and Bank Indicator. Pitch and Bank Indicator.

ALL-AMERICAN GLIDER KIT

COMPLETE WITH KIT
Price \$50.00
Includes: 1. Plans, 2. Materials, 3. Tools, 4. Instructions.

Airplanes & Engines

Overhauled—Rebuilt—Rebuilt
All work to specification with
State of Connecticut approval.

Westchester Airport Corp.
1234 5th Avenue, New York 17, N.Y.

STEARMAN and AEROMARINE KLEMM

OPEN & NEW 1937
1234 5th Avenue, New York 17, N.Y.

PITCH INDICATOR
Available in 1/2" and 1" sizes.
1234 5th Avenue, New York 17, N.Y.

STARBOARD
Developed especially for use on
single engine aircraft, amphibian and
motor.

JOHN & COX & SON
1234 5th Avenue, New York 17, N.Y.

JOHN & COX & SON
1234 5th Avenue, New York 17, N.Y.

STARBOARD
Developed especially for use on
single engine aircraft, amphibian and
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